Some industry pundits, particularly those sympathetic to ILEC positions, believe that TELRIC pricing will be phased out and that eventually element prices will be based more on historical or opportunity costs than on forward-looking costs. There is little evidence from either the FCC or state regulatory commissions that TELRIC will be abandoned, or that historical costs, properly measured, exceed TELRIC. Nevertheless, the risk of dramatic changes in element rates (perhaps due to changes in pricing standard) cannot be trivialized.[53] Today, element rates are determined by regulatory fiat, and regulators can be fickle. Element-rate sabotage is a constant, though perhaps weak, threat.

Moreover, as Table 1 illustrates, those CLECs with a heavy dependence on ILEC facilities are required to sink other significant entry costs as well. For example, the sunk costs of systems and customer acquisition are not small. Nevertheless, the sunk costs of an element-dependent entry strategy are much less than those of a network-based entry strategy. Network facilities can be a severe drain on an entrant's resources and they substantially raise the risk of entry. Further, the speed with which customers can be acquired may not allow the entrant to exhaust the inherent scale economies in telecommunications plant.

Despite these risks of investing in telecommunications plants, some EDEs have duplicated major components of the ILECs' network to provide services. For example, switch-based CLECs typically acquire loop facilities from the ILEC, but cross-connect those loops to their switch and collocated equipment. DSL providers, similarly, cross-connect loop plant over to their collocation. While this hybrid element-facilities approach reduces reliance on the ILEC, substantial sunk costs are nonetheless required. Further, given the highly manual loop cutover process, the degrees of freedom for sabotage are expanded.

FCC, 2001 WL 893893 (U.S. Sup. Ct. 2001) (No. 00-511); Respondent's Brief, FCC v. Iowa Utils. Bd., 2001 WL 705629 (U.S. Sup. Ct. 2001) (No. 00-511, 00-555, 00-587, 00-590, 00-602); Respondent's Brief, WorldCom, Inc. v. Verizon Comms., Inc., 2001 WL 881072 (U.S. Sup. Ct. 2001) (No. 00-555, 00-587, 00-590); Petitioner's Brief, Verizon Comms., Inc. v. FCC, 2001 WL 705546 (U.S. Sup. Ct. 2001) (No. 00-511). Comments of Verizon Comms., Inc. Before the Nat'l Telecomms. and Info. Admin., *Request for Comments on Deployment of Broadband Networks and Advanced Telecommunications*, Docket No. 011109273-1273-01, (Dec. 19, 2000), *available at* http://www.ntia.doc.gov/ntiahome/broadband/comments/verizon/verizon.htm.

53. *First Report and Order*, *supra* note 50, paras. 555-607 (noting that the FCC's decision to adopt the TELRIC pricing methodology is on *certiorari* with the Supreme Court and oral arguments were held on October 10, 2001). *Cf. Iowa Utils. Bd.*, 120 F.3d 753 (upholding the FCC's generic authority to develop a pricing methodology under the 1996 Act).

The "smart-build" approach, where facilities are deployed in a highly controlled and meticulous fashion, has met with limited success, as have virtually all CLEC entry strategies. Nevertheless, the heavy burden of facilities deployment and the slow, arduous customer acquisition process have sent many CLECs to the grave.[54] *Further, while the light use of ILEC facilities reduces reliance on the reluctant supplier, the ability of the ILECs to disrupt CLECs' business plans is not removed.* Indeed, in some cases, those CLECs deploying their own plant to complement the ILECs' elements require even more ILEC intervention to provide service (e.g., the manual hot-cut process) than the more pure EDEs.

These hybrid entrants—those using both ILEC elements and their own facilities—represent the bulk of CLEC bankruptcies over the past year or so. This group consists primarily of those providers adopting the "build it and they will come" business plan. Not all of the hybrids will fail, however. On the other hand, other CLECs, with hundreds of millions in debt and slow revenue growth, probably never had a chance.[55] DSL provider Northpoint, for example, carried about $500 million in debt; $24 million in quarterly revenues, growing at 10% quarterly; and just over $100 million in quarterly costs, growing at 20% quarterly. This includes cost of goods sold and sales, general and administrative costs. As such, Northpoint and similarly situated CLECs were doomed from the outset.

While hope remains for a few of the hybrid entrants, the impact of the hybrid entrant on competition unfortunately will be *de minimis*. For example, switch-based CLECs face a severe constraint on migrating customers to their network: the highly manual hot-cut process. Every customer a switch-based CLEC acquires must be hot-cut over to the CLEC's collocation equipment.

Consider the effect of hot-cuts on competition in New York. In New York, about 7,000 hot-cuts are performed each month.[56] Assuming a 4% monthly churn rate, the number of access lines that CLECs can service at

54. A recent NEW YORK TIMES article illustrates this fact, noting that during 2001 the number of CLECs has declined from more than 200 to about 75. *See* Ilve Tahmincioglu, *A Phone Upstart, Still Annoying the Giants*, N.Y. TIMES, Nov. 4, 2001, § 3, at 6.

55. *See, e.g.*, Gregory Zuckerman & Deborah Solomon, *Telecom Debt Debacle Could Lead to Losses of Historic Proportions*, WALL ST. J., May 11, 2001, at A1.

56. This estimate is based on data from December 2000, when Verizon performed 6,878 hot-cuts. Letter to Honorable Janet H. Deixler, Secretary, New York Public Service Commission, Three Empire State Plaza, Albany, New York 12223 from William D. Smith, Senior Regulatory Counsel, Verizon, New York, Inc. 1095 Ave. of the Americas, Room 3733, New York, NY 10036, Re: Cases 97-C-0271and 99-C-0949 (Jan. 25, 2001) (on file with Journal). While the 6,000 hot-cuts is an averaged level of demand, hot-cuts do have a physical capacity constraint that is far less than that for UNE-P, because UNE-P migration, in most cases, does not require manual intervention.

existing hot-cut rates in New York in three years is about 135,000 lines, including the effect of churn. According to FCC ARMIS data, there are about 12 million access lines in New York, and this figure has been growing at about 0.25% per month during the past five years.[57] After three years of hot-cuts, roughly 1% of the total New York market could be served by switch-based CLECs.[58] Even with no churn, the percent of customers that switch-based CLECs could service is only 1.85%.[59]

As a point of reference, in December 2000, about 300,000 UNE-P and UNE-P equivalent lines were provisioned to CLECs.[60] In other words, UNE-P can produce a level of competition in a single month that switch-based CLECs cannot exceed even after three years (even with zero churn). In fact, UNE-P can provide service to nearly ten times as many customers in six months than could switch-based CLECs after ten years of hot-cuts, assuming current hot-cut levels.[61] As discussed *supra*, the rapid migration of customers to EDEs is important for the future of network-based competition.

B. *Network-Based Entrants: The "Builders"*

While we divide entrants into EDEs and network-based entrants ("NBEs"), it is generally the case that all CLECs use the incumbent's network to some degree. NBE means carriers that rely more heavily on their own facilities, using the dominant incumbent's network only in special circumstances. CLECs in this group at the time of this writing include Time Warner Telecom, XO Communications, RCN, and bankrupt firms such as Teligent and Winstar.[62] NBEs generally target medium-large

57. ARMIS Form 43-08 (multiple years), *at* http://www.fcc.gov/ccb/armis.

58. *Id.* The estimated CLEC share is computed as the net sum of the hot-cut access lines growing at 7,000 hot-cuts per month, but declining at 4% per month on the cumulative stock of CLEC lines, divided by the forecast access lines of Verizon (growing at 0.25% per month).

59. *Id.* The hot-cut customer base is assumed to grow at 7,000 lines per month, with no customer churn on the existing stock.

60. Letter to Honorable Janet H. Deixler, *supra* note 56. UNE-P migration levels are based on Verizon and CLEC customer activations during Dec. 2000. Both Verizon and CLEC activations are included because they are functionally equivalent and, therefore, are a better measure of account-activation capacity.

61. The estimated CLEC share on UNE-P is computed as the net sum of migrated UNE-P access lines growing at 300,000 migrations per month, but declining at 4% per month on the cumulative stock of CLEC UNE-P lines, divided by the forecast access lines of Verizon (growing at .025% per month). See footnote 59 for computations of hot-cut lines.

62. *Cf.* Richard Waters, *Crunch Time for the US Telecoms Industry*, FIN. TIMES, Apr. 30, 2001, at 26. Neither Time Warner nor XO Communications serves the mass market of analog telephone service.

and large businesses, and possibly residential multiple-dwelling units in metropolitan markets.

The sunk costs and economies of scale endemic to the local exchange market are discussed *supra*. Sunk costs raise the risk of entry, and the economies of scale associated with fixed/sunk costs require large market shares to attain profitability. The CLEC industry today is well aware of the difficulty of achieving scale economies and doing so relatively quickly.

The capital required of the NBE is substantial. As shown in Table 1, entry costs for XO Communications exceed $11 billion. Despite these large entry costs, about a third of which is in plant, the addressable market of XO Communications is relatively small. RCN Communications, with a network construction that is limited to the most densely populated areas, has entry costs of nearly $6 billion for a total addressable market of about 1.5 million households (totaling 1.3% of U.S. households). Access to this kind of capital by a large number of CLECs is unlikely.

Moreover, just as with the EDEs, the regulatory risks for NBEs are far from trivial. Permits and other government approval costs, again, mostly sunk in nature, average about 10% of total project costs.[63] Given that these costs are incurred prior to even receiving permission to construct, up-front investments in lengthy regulatory efforts substantially increase risk. In some cases, permission is not granted or is too costly, and these projects are consequently aborted.

While it seems that network-based entry would eliminate the prospects for ILEC strategic, anticompetitive behavior, even network-based entrants run into trouble with the incumbents. As one NBE observed, "When you go to the incumbents, the inventory of conduit always seems to be shrinking. They want you to go out and dig up the street and run up your own costs."[64] Thus, even those entrants that are network-based in nearly every respect must interact with the ILEC.

Moreover, the omnipresent regulatory risk in telecommunications even impacts the NBEs: "We're in a legal struggle right now where [the incumbent is] trying to say that we don't meet the definition of a CLEC because we're a 'carriers' carrier.' They don't want to unbundle anything."[65] Accordingly, it appears that even dividing up entrants as element-dependent or networked-based is problematic. Every entrant must deal with the incumbent and is a potential victim of sabotage; it is just a matter of degree.

63. Sweeney, *supra* note 16, at 10.

64. *Id.* at 9.

65. *Id.*

IV. THE MODEL

The review of current entry strategies reveals two common themes. First, *the dominant, vertically integrated incumbent firm has powerful incentives to hinder, if not completely put out of action, those CLECs relying on its unbundled elements to provide service*. When an ILEC sells an unbundled loop to a CLEC in the wholesale market, that loop will almost certainly be used to serve a current customer of the ILEC in the retail market. If service provision is mutually exclusive, then the ILEC will lose that customer and the monthly margin associated with that customer. If the regulated price for elements does not compensate the ILEC fully for its cost and lost margin, then the ILEC is motivated to sabotage the transaction. Second, *entry into the local exchange market by a large number of providers likely will require access to unbundled elements supplied by either the ILEC or a CLEC*.

These basic ideas, mixed with the influence of scale economies and regulation, serve as the foundation for the economic model of incentives presented in this Section. While the presentation of the model is greatly simplified for consumption by a broad audience, the model is technical by its very nature. Numerical examples are provided at the end of the Section for those wanting to avoid the more technical presentation.

A. *Primary Assumptions of the Model*

All analyses are based on a particular set of assumptions, and this analysis is no exception. The assumptions chosen here simplify the analysis while capturing the salient features of the telecommunications markets under investigation. The assumptions used in the model here include the following:

(a) There is a large, integrated (wholesale and retail) incumbent (the ILEC) that is legally obligated to sell unbundled network elements to retail competitors at regulated prices;

(b) These incumbents may "sabotage" this process through nonprice means;

(c) Scale (or density) economies exist in network or wholesale operations, and these economies may be substantial;

(d) While scale economies may exist in retail operations, these economies are smaller than those in wholesale operations; and

(e) Wholesale services and elements are required to provide retail services, on a "one-for-one" basis.

The following notation simplifies the model

MS_j — retail market share (% of total market sales) enjoyed by firm j
- $j = 1$ dominant firm
- $j = i$ other integrated firms
- $j = a, b, c \ldots$ stand-alone, nondominant retail firms;

S_k — wholesale market share (% of total market sales) enjoyed by firm k
- $k = 1$ dominant firm
- $k = i$ other integrated firms
- $k = n$ stand-alone, nondominant retail firms;

γ — typical retail margin (revenues less retail costs and other service costs on a per-customer basis);

$C(S)$ — total economic costs of a network of "size" S, representing all costs of the physical network and its operations with $C' > 0$, $C'' \leq 0$, and $C(0) = 0$;[66]

$\hat{r}$ — regulated price of a piece of the network ("elements") used to provide service to retail customers;

z — per-unit costs imposed on a competitor by a dominant provider of elements that do not result in a revenue to the provider, i.e. nefarious "sabotage";

r_i — unregulated price of a network element sold by an integrated, nondominant firm, to a retail competitor of the seller;

r_n — unregulated price of a network element sold by a firm having no other business to a firm offering retail services.

66. The notation $C'(S)$ indicates marginal cost, where marginal cost is the first derivative of the cost function with respect to the quantity of element produced. The second derivative of the cost function is $C''(S)$. These assumptions merely imply that producing elements is costly ($C'(S) > 0$), but that there are scale economies in this process ($C''(S) \leq 0$) and no fixed costs ($C(0) = 0$). Economies of scale could be defined as declining average cost (i.e., fixed costs are positive) with no change in the conclusions of the paper.

The following additional "empirical generalizations" are used in what follows: (a) the incumbent, integrated firm does not wish to sell elements to competitors at price $\bar{r}$; and (b) margins and prices are such that retail competition is viable if retail competitors are able to obtain elements at the long-run average costs of an efficient competitor. The first generalization implies that the regulated rate for the element is below the opportunity cost of the element for the dominant incumbent, whereas the second generalization ensures that competition is viable and thus a reasonable expectation and policy goal.

B. The Cost of Selling Elements

The next step in the analysis is to characterize the opportunity costs of selling elements by integrated and unintegrated firms. Consider an integrated firm with network market share S and retail market share MS. The marginal opportunity cost of transferring control of one element to a competitor, L is then:

$$L = C'(S) + MS \cdot \gamma \tag{2}$$

where the first term, $C'(S)$, represents the ordinary marginal cost of an element given a network of size S.[67] The second term, $MS \cdot \gamma$, illustrates the potential impact of the sale on the retail portion of the seller's operations. Given a retail market share of MS, the (naive) probability that the sale of the element results in a lost retail account is MS. *In other words, if the seller has 50% of the market, then there is a 50% chance that the purchaser of the element is then using that element to serve an existing customer of the seller.* Since a typical account produces a margin of γ, the expected lost retail margin on the sale is $MS \cdot \gamma$, and the total cost of the element transfer is therefore $C'(S) + MS \cdot \gamma$, the marginal cost plus the lost retail margin of the element.[68]

67. The Efficient Component Pricing Rule ("ECPR") calls for a price equal to L. TELRIC pricing is roughly equivalent to average cost pricing, or $C(S)/S$.

68. The Authors assume, for simplicity, that the retail margin γ is not affected by the sale of one element.

Two important points arise here. First, a seller with a larger network (i.e., S is larger) enjoys a lower marginal cost; if $S_a > S_b$, then $C'(S_a) < C'(S_b)$. In other words, there are economies of scale. Second, a seller with a larger retail operation faces a higher opportunity cost, L, since the sale of an element to a competitor is more likely to result in a lost retail account. The relationships between the opportunity cost, $C'(S) + MS \cdot \gamma$, and the shares S and MS are illustrated in Figure 1.

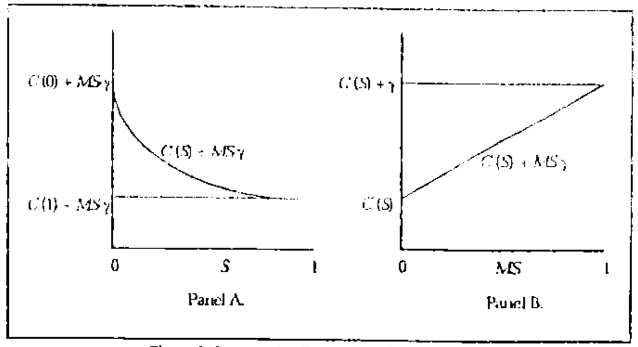


Figure 1. Opportunity Cost and Market Share

The relationship between wholesale market share and opportunity costs is illustrated in Panel A. For a given market share and retail margin, opportunity costs are declining in wholesale market share. This relationship also implies that marginal cost, $C'(S)$, is declining in wholesale market share (there are economies of scale). Panel B illustrates the relationship between retail market share and opportunity costs. With marginal production cost constant, the larger the market share of the firm, the larger the opportunity cost. This relationship is based on the expected relationship between the forgone retail margin and the sale of an element, since marginal production costs are constant.

Because a wholesale-only firm has no retail market share, the opportunity cost of providing an element for a wholesale-only firm is just $C'(S)$. Given the existence of scale economies, a price of $C'(S)$ is not consistent with long-term financial success. Scale economies imply that marginal cost lies below average cost, so that a price equal to marginal cost does not fully recover the total cost of the firm. Long-run average cost, $C(S)/S$, is the minimum price consistent with viability of a wholesale-only seller.[69]

C. *The Price of Elements*

The next step in the model is to analyze the conditions under which element sales can be made. Figure 2 illustrates the opportunity cost to the dominant firm from selling one or a few elements, and the regulated level of remuneration they obtain from such sales ($\bar{r}$).

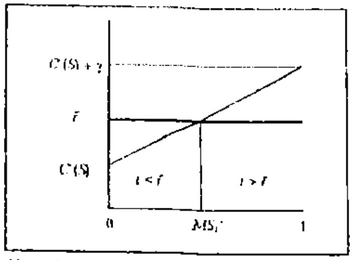


Figure 2. Revenue, Opportunity Cost and Market Share

The model assumes on Figure 2 that $\bar{r}$ is sufficiently high: $\bar{r} \geq C'(S_i)$, where $\bar{r}$ exceeds the long-run incremental cost of the dominant firm. This is not the same as assuming $\bar{r}$ is remunerative, however, since scale economies are present. The analyses to follow do not depend on this relationship.

Figure 2 illustrates an important fact: the dominant incumbent is willing to sell an element at price of $\bar{r}$ only if $MS_i < MS_i^*$ where $t < \bar{r}$. At all higher market shares, the opportunity cost t exceeds $\bar{r}$ and the incumbent is unwilling to sell elements. This unwillingness to sell elements is driven by the lost retail margin of the dominant incumbent $MS \cdot \gamma$. The conclusion is strengthened if γ falls as element sales are made because the seller is marginalizing; the elements reduce the margin on all units sold in the retail operation of the seller.[70] Thus, if element sales increase price competition in

69. Note that $C(S)/S$ is the functional equivalent of TELRIC.

70. Lower retail margins reduce opportunity costs and thus encourage element sales. However, the seller will not purposefully reduce its retail margin through the sale of elements to reduce its opportunity costs; the reduced margin affects all customers.

the retail market, then the incumbent's incentive to sell elements in the wholesale market is diminished. For simplicity, this model considers the sale of a single element with presumably negligible effects on retail margins. Nevertheless, the impact of price competition on the incumbent's incentives is noteworthy.

D. *Sabotage*

"Sabotage," as used in this Article, has a very specific definition, that is, the ability of a dominant firm to raise the cost of a rival's key input of production by nonprice behavior. While sabotage can occur in a variety of contexts, the inherent tension created by the wholesale supplier versus retail competitor conflict, especially when the wholesale price is regulated, provides fertile ground for abuse. That is to say, the dominant, integrated firm is regulated and is legally required to sell elements at price $\bar{r}$. Here, however, experience highlights the substantial gulf between the requirements of the 1996 Act and reality. Suppose that the regulated, dominant firm can impose nonprice costs of z, where $z \geq 0$, per element on buyers, although they will earn no revenue by this action; that is, z is a cost to buyers but not a revenue to the seller.[71] Given this possibility, at what level, if any, would the dominant firm choose to sell?

It is clear that, when $MS_i < MS_i^*$ the dominant incumbent does not want to sell elements. Thus, in this situation, z will be set at its maximum feasible value to impede the sale of elements. Because the sale of a single element is undesirable, the sale of more than one element is also undesirable because a larger quantity of elements sold is more likely to reduce or merely not increase the retail margin.[72] Cost-based prices do not, and should not, incorporate such margins. Thus, cost-based prices are set below the opportunity cost of the incumbent. *Consequently, to the extent that the incumbent dominant firm is able to impose costs on rivals, its incentives are to do so.*[73]

71. Beard et al., *supra* note 11, at 105.

72. The model shows that the dominant incumbent will not sell one element. This specification of the model is for convenience, but the same result holds for larger quantities of elements sold.

73. A similar situation can be observed in the market for multichannel-delivered video programming. There, both the upstream (programming) and downstream (distribution) markets are also characterized by high sunk costs and the necessity of achieving scale economies. For this reason, many cable multiple system operators ("MSOs") sought to mitigate their risks by vertically integrating with popular cable networks. As access to these popular cable networks was key to the ability of a competitor—such as satellite providers or cable overbuilders—to succeed in the market, these vertically integrated cable MSOs had a strong incentive to engage in strategic anticompetitive conduct against their rivals and ultimately did. In order to stop such anticompetitive conduct, Congress was forced to

E. Sales by a Vertically Integrated Nondominant CLEC Provider

What of element sales by a nondominant vertically integrated CLEC provider? The above analysis can be extended beyond the dominant incumbent to any integrated seller, including CLECs. An integrated seller is willing to sell an element at any price r only if its market share is less than a critical value determined by $C'(S)$, γ_s and MS_r. For example, an integrated but nondominant seller would sell an element at price r only if $r > C'(S) + MS_r \cdot \gamma$. Of course, such a price may not be remunerative with substantial scale economies at S, but this relationship serves as a lower boundary. Note that the value of $C'(S)$ may be quite high when S is small, as are many CLECs, due to scale economies in network elements.

Competition, to the extent that it exists among sellers of elements, may impose a maximum price that any given integrated seller can charge for an element. If so, call that price r_{max}. Given S, γ, and MS_r we may well have $MS_r > MS_r^*$ for r_{max}, implying no sales of elements by larger integrated, unregulated firms because the large retail market share increases the opportunity costs of such sales. This "no sales of elements" strategy is more likely when retail operations of the firm (MS_r) are larger, the retail margin (γ) is larger, and the wholesale operations of the firm (S) are smaller. Importantly, the nondominant supplier's wholesale rates are unregulated, so there is no incentive for strategic nonprice anticompetitive behavior. The nondominant wholesale firm responds to its incentives by adjusting price.

Clearly then, the presence of scale economies also affects the behavior of vertically integrated CLECs as well, but in what way? The model indicates that while a vertically integrated CLEC may not opt for a separate wholesale business strategy in addition to its retail operations, the CLEC will not go out of its way to frustrate entry as the ILEC would. That is, *sabotage is the result of regulated prices for elements that are below the opportunity cost, but not necessarily the average cost, of the incumbent.* Yet, because the price for elements is not prescribed for unregulated sellers (CLECs), these firms have no incentive to sabotage transactions. However, as also noted above, the higher the opportunity cost of the unregulated firm, the higher is r—the price at which the unregulated firm will sell elements.

promulgate the Program Access rules in the 1992 Cable Act to require vertically integrated MSOs who deliver programming over satellite to demonstrate why their exclusive distribution programming contracts were in the public interest. 47 U.S.C. § 548 (Supp. V 1999). For a full exegesis of the Program Access paradigm, *see* James W. Olson & Lawrence J. Spiwak, *Can Short-Term Limits on Strategic Vertical Restraints Improve Long-Term Cable Industry Market Performance?*, 13 CARDOZO ARTS & ENT. L.J. 283 (1995); *see also* George S. Ford & John D. Jackson, *Horizontal Concentration and Vertical Integration in the Cable Television Industry*, 12 REV. OF INDUS. ORG. 501, 504-06 (1997).

The element price r is decreasing in S, and increasing in MS and γ. *Accordingly, a fully integrated nondominant CLEC provider with a significant market share in the retail market will not affirmatively seek to thwart entry. Instead, this CLEC will simply offer elements to the wholesale market at "high" prices. As a result, while an EDE may be able to purchase some elements from a CLEC for short-term purposes, purchasing elements from the ILEC is always fraught with peril.*

F. Summary of Model with a Numerical Example

Although of a fairly technical nature, the model described here merely formalizes a fairly simple and common-sense notion: whenever an integrated firm sells a network element, or network services, to a retail competitor, there is a chance that sale will cause the integrated firm to lose a customer to the buyer. In a sense, such sales to retail competitors involve the risk of also "selling" a valued customer, and the integrated firm will recognize this fact in its actions toward those seeking wholesale services. Further, the risk of such a loss to the seller is related directly to the seller's market share in the relevant market. For example, a firm with a near-monopoly in the retail market will almost surely lose a customer if it supplies a retail competitor with the ability to offer further retail services. There is, after all, almost nowhere else from which such a customer could come.

The reluctance of integrated sellers to sell elements or wholesale services can be measured by the prices they would induce to voluntarily sell such elements to competitors. Further, in order for elements to be sold by an integrated firm, the price charged must also be below the potential earnings of the buyer, so that the sale is economically sound for the retail firm. The analysis presented here allows this requirement to be analyzed and understood using simple numerical examples.

To make it concrete, suppose that in some given market the economic cost of the necessary element—$C'(S)$ in the model—is \$15 per month for a firm with a 50% market share in the wholesale market. Suppose further that, given the additional costs arising from retailing, an efficient retail service supplier could expect to earn a margin of \$25 per month—γ in the model—not counting the costs of the wholesale element. This implies that, given an element of cost \$15, a customer in hand is worth \$10 (\$25-\$15). Then, the prices in the second column of Table 2, r_{*} in the model, would be required by the integrated seller in order to induce them to sell the element, with these figures related to the integrated firm's market share in the relevant market.

Table 2. Minimum Element Prices

Retail Market Share (MS)	Minimum Element Price (r_{min})
0%	15.00
25%	17.50
50%	20.00
75%	22.50
100%	25.00

Although a very simple example, these calculations show that the willingness of an integrated seller to provide a wholesale service to a retail competitor is directly and positively related to the retail market share of the integrated firm. Since a potential competitive retailer that might seek to buy elements is likely to be operating on lower margins than the existing dominant firm, element prices of the sort illustrated here can be expected to substantially reduce the sales of elements and the emergence of competition at the retail stage.

G. *Market Examples*

Because there are no integrated, nondominant CLEC suppliers of local exchange elements, comparable examples must be found elsewhere. As an analogy, consider the wholesale market for long-distance services, where the "element" in this context is access to a nationwide long-distance network. In the long-distance market, the retail market share variable MS is properly characterized as the underlying carrier's national market share; the long-distance market is national in scope. Any customer of an integrated interexchange carrier is potential prey for a retail carrier using the facilities of the integrated firm. Assuming γ is equal across firms and scale economies are exhausted for all national long-distance networks, the expectation is that the price charged by interexchange carriers with large retail market shares would be higher than those without such shares.

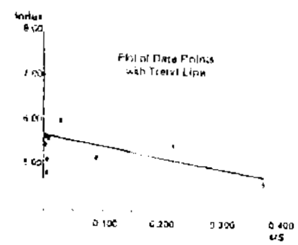
Table 3 provides an analysis of customer perceptions of a representative sampling of wholesale carrier price points and the respective carriers' retail market share. The model suggests that AT&T, the largest retail provider of long-distance service, would have the highest prices for wholesale capacity. Table 3 indicates that customers and potential customers of AT&T wholesale capacity view its prices as relatively high, resulting in the lowest rating for pricing (4.26). Further, those carriers with the smallest retail market shares are given the highest rating for pricing (7.00). While the data presented in Table 3 are not perfectly comparable to

the analysis above (the market share data are not perfectly analogous and other factors influence price), the general relationship is compatible with expectations. Furthermore, while AT&T has the largest network and largest retail market share, MCI-WorldCom is the largest wholesale carrier. It appears that AT&T's retail market share continues to influence the company's behavior in the long-distance wholesale market.

Table 3. Pricing Satisfaction and Market Share of Interexchange Carriers[74]

Carrier	Pricing Satisfaction Index*	Market Share
AT&T	4.56	0.376
Cable & Wireless	5.08	0.008
Global Crossing	5.57	0.008
Broadwing	4.79	0.006
MCI WorldCom	5.42	0.235
Qwest	5.98	0.030
Sprint	5.15	0.090
Teleglobe	5.42	0.003
Williams	5.63	0.004
Misc. Small Carriers	7.00	N/A
Mean	5.49	

* Higher values indicate lower prices.



In stark contrast to the highly competitive market for wholesale capacity in long-distance services, the wholesale market for the U.S. wireless industry is immature. The opportunity cost model sheds some light on this fact. Historically, the margins (γ) for wireless service have been quite high. Further, the wireless carriers have only recently begun to exhaust scale economies, suggesting $C'(S)$ was large historically. Today, market shares have somewhat stabilized, allowing wireless carriers to better assess their opportunity costs. With wireless margins lower, market shares stable and disparate, and scale economies near exhaustion for some carriers, the model presented above suggests that a wholesale market in

74. Judy Reed Smith & Taher Bouzayen, *Resellers Rate Wholesale Carriers*, PHONE+, March, 2000; Trends in Telephone Service, Federal Communications Commission, August 2001 (Data for year 2000), at Table 10.1.

wireless telecommunications may emerge.

Notwithstanding the situation in the United States, the formation of such a wholesale wireless market is nonetheless well under way in the rest of the world. These self-described mobile virtual network operators ("MVNOs") such as Virgin Mobile, Sense Communications, and the Financial Times Group (firms that are essentially "marketing machines")[75] are all making significant headway in numerous markets in Europe, Asia, and Australia.[76] Not surprisingly, recent trade press reports reveal that several U.S. wireless carriers are warming up to the idea of offering their capacity as wholesale suppliers as well.[77]

75. *See, e.g.*, Reuters, *Branson to Use Virgin Airline as Mobile Weapon*, TOTAL TELECOM, Sept. 3, 2001, *available at* http://www.totaltele.com/view.asp?articleID=43387&Pub=TT&categoryid=828&kw=Branson+louse=Virgin.

76. *See, e.g.*, *Telecom NZ's AAPT Looks for Australia MVNO Deals*, TOTAL TELECOM, Sept. 17, 2001, *available at* http://www.totaltele.com/view.asp?articleID=43860&Pub=TT&categoryid=828&kw=Telecom+NZ; *Virgin Plans US$530m Asian Spend, Sees HK Partner Soon*, TOTAL TELECOM, June 12, 2001, *available at* http://www.totaltele.com/view.asp?articleID 40900&Pub TT&categoryid 828&kw Virgin+ (noting, according to Ross Cormack, Chief Executive of Virgin Mobile (Asia), that the U.K.-based Virgin Group "plans to spend US$530 million on expanding its mobile virtual network operations in 10 Asian regions over the next three to five years"); Ray Le Maistre, *Operators: MVNOs - Not All Virgins*, ROAM, June 1, 2001, *available at* http://www.totaltele.com/roam/ view.asp?articleID=40602&Pub=RM&categoryid=705&kw=Virgins; George Malim, *COR Boosts the Power of Smaller MVNOs*, TOTAL TELECOM, May 21, 2001, *available at* http://www.totaltele.com/view.asp?articleID=40104&Pub=CWI&categoryid=705&kw=COR;Annie Turner, *Mobile Virtual Network Operators: Taking Root*, NEW CARRIER, Apr. 1, 2001, *available at* http://www.totaltele.com/newcarrier/view.asp?articleID=39455&Pub=NC&categoryid=705&kw=Root; Anne Young, *FT and the Carphone Warehouse Form MVNO Deal with Cellnet*, TOTAL TELECOM, Mar. 5, 2001, *available at* http:// www.totaltele.com/view.asp?articleID=37582&Pub=TT&categoryid=625&kw=Carphone; Joanne Taaffe, *Mobile Virtual Network Operators - Marking Out Their Territory*, COMMUNS. WEEK INT'L, Mar. 5, 2001, *available at* http://www.totaltele.com/view.asp?articleID=37530&Pub=CWI&categoryid 705&kw Mobile+Virtual+Network; Anne Young, *MVNOs: A Market Essential or an Operator's Bete Noire?*, TOTAL TELECOM, Feb. 22, 2001, *available at* http://www.totaltele.com/view.asp?articleID=37255&Pub=TT&categoryid=625&kw=Bete+Noire; Gerard O'Dwyer, *Norwegian MVNO Sees Sense in Nordic Expansion*, TOTAL TELECOM, Feb. 6, 2001, *available at* http://www.totaltele.com/view.asp?articleID=36637&Pub=TT&categoryid=625&kw=Norwegian+MVNO; Emma McClune, *3G Owners Awash with Virtual Partner Offers*, COMMUNS. WEEK INT'L, Jan. 15, 2001, *available at* http://www.totaltele.com/view.asp?articleID=35683&Pub=CWI&categoryid=705&kw=3G+owners.

77. *See, e.g.*, Bruce Christian, *Wanted: Channels for Wireless*, PHONE+, Mar. 2001, *at* http://www.phoneplusmag.com/articles/131cover.html; *Virgin Teams Up With Sprint for U.S. Services*, REUTERS, Oct. 5, 2001; *Sprint, Virgin Form Wireless Joint Venture Aimed at 15- to 30-Year Olds*, BUS. J., Oct. 5, 2001, *at* http://www.kansascity.bizjournals.com/kansascity/stories/2001/10/01/daily46.html; Thor Olavsrud, *Sprint, Virgin Create Wireless Joint Venture*, WIRELESS NEWS, Oct. 5, 2001, *at* http://www.internetnews.com/wireless/article/0,,10692_898121,00.html.

V. IMPLICATIONS OF THE MODEL AND THE CASE FOR AN ADCO

A. *Emerging Trends*

The analysis above indicates that the opportunity cost of selling elements rises as wholesale market share declines and retail market share increases (holding the retail margin constant), suggesting the following possible conclusions. First, there is reason to believe that *no integrated firm with large retail presence will emerge as an efficient, cost-based supplier of network elements to retail competitors. Moreover, the regulated, dominant firm, and any larger integrated firm, may well be reluctant to create its own competition through element sales.* For both dominant and nondominant providers, there is a clash between scale economies on the one hand and retail market share on the other. Size does matter, so to speak, but in conflicting ways. For an integrated provider offering no elements to the wholesale market, wholesale (S) and retail market share (MS) are highly correlated. The opportunity cost of selling elements declines as wholesale market share increases; the opportunity cost of selling elements increases as retail market share increases. *Thus, it is quite possible that the lowest cost providers—those exhausting economies of scale—do not participate in the wholesale market, particularly at better prices, because of a high retail market share.*

Second, the presence of scale economies suggests that small wholesale firms, or retailer self-supply, may likewise be noneconomic. *Realizing economies of scale affects profitability; thus, exhausting scale economies is desirable. However, doing so may be difficult if wholesale market share is tied directly to retail market share.* An integrated firm may be unable to acquire sufficient retail share to exhaust scale economies at the wholesale level. The retail market share of the firm, however, may impede the firm's ability to increase wholesale sales to achieve scale economies by raising the opportunity cost of element sales. Thus, numerous forces operate against the prospect of wholesale supply by integrated firms, whether dominant or nondominant.

Similarly, *a large retail market share indicates that the incumbent will have a significant incentive to sabotage and discriminate against rivals in the wholesale market.* Further, *the scale economies in the local market are more significant than in long-haul networks and therefore it is unclear whether individual EDEs will ever acquire sufficient market share to justify the construction of network for their exclusive use.* As such, *for those firms that rely heavily, if not exclusively, on the incumbent to provide wholesale elements at just and reasonable rates, the economics do not bode well for long-term viability.*

What, then, is the alternative? The analysis presented here illustrates a potential market-based solution to this dilemma: the entry of the wholesale-only firm or ADCo. Such a firm can offer retail entrants the immediate advantages of larger scale, thus obtaining scale economies in network operation, without the retail-market-share-driven disincentives to wholesale supply. In addition, given the wholesale nature of the ADCo and advances in technology, retail entrants can use the ADCo's facilities (i.e., essentially a "dumb pipe") to provide customers with custom-tailored products and services that the incumbent network is simply unwilling or unable to provide (e.g., managed IP services). Accordingly, while the number of local access networks the market can sustain may be *few*, the wholesale nature of the ADCo nonetheless permits the number of providers of advanced telecommunications products and services in the local market to be *many*.

Specifically, an ADCo can and is willing to offer elements with an economic cost of $C'(S_i)$, and at a fully remunerative price of $C(S_i)/S_i$ (i.e., average cost). So long as such a firm is able to achieve sufficient scale economics, it may well be that $C(S_i)/S_i < r_{min}$, where:

$$r_{min} = \min\{C(S_1) + MS_1 \cdot \gamma, C(S_i) + MS_i \cdot \gamma\}$$

or, equivalently,

$$r_{min} = \min\{r + z, C(S_i) + MS_i \cdot \gamma\}.$$

In other words, the average cost of the ADCo may be below the opportunity cost (or minimum element price) of its potential integrated rivals.[78]

Table 2 above can be expanded to include the minimum price of the ADCo, assuming that the ADCo and the integrated provider have the same cost function, but that ADCo, by definition, has no retail market share. Thus, the minimum remunerative element price for ADCo is equal to its average cost ($C(S)/S$) or TELRIC—$18.00 in this case.[79] As shown in Table 4, ADCo's price is below the integrated firm's price in some cases. As the retail market share of the integrated firm rises, the ADCo price is below the integrated firm's price. The difference in prices is the result of the retail

78. If not, then retail firms will pay the integrated providers their opportunity cost.

79. The ADCo cannot sell elements at marginal cost, whereas the incumbent may do so because its network costs are sunk. In other words, an ADCo would not enter the market and incur sunk costs, if its expected price did not exceed marginal cost.

market share disincentive ($MS \cdot \gamma$) possessed by the integrated firm.

Table 4. Minimum Element Prices

Integrated Firm's Retail Market Share (MS)	Integrated Firm's Minimum Element Price (r_{min})	ADCO Minimum Element Price (r_{min})
0%	15.00	18.00
25%	17.50	18.00
50%	20.00	18.00
75%	22.50	18.00
100%	25.00	18.00

The condition under which the ADCo can profitably service the wholesale market does not require that the ADCo exhaust its scale economies. Even if the ADCo is somewhat less efficient than larger providers, due to a smaller size, the lack of the retail-driven disincentive may allow the ADCo to profitably supply a wholesale market. Thus, the presence of more efficient, integrated firms is immaterial so long as the retail-driven disincentive to supply the wholesale market is sufficiently large.

B. *Residual Public Interest Benefits—The Impact of the ADCo on the Incentives of the Dominant Incumbent*

Perhaps the most important benefit of the ADCo would be its potential effect on the incentives of the dominant incumbent to exercise market power (i.e., by raising prices or restricting output) or to engage in efforts to deter new entry via strategic nonprice behavior.

For example, it may just be possible that an ADCo, and its customers serving the retail market could grow large enough that the market shares of the integrated firms, both wholesale and retail, fall sufficiently to render them valid competitors in the wholesale market.[80] Thus, like structural separation of the dominant provider that aims to eliminate the retail disincentive in a more direct way, the ADCo can alter the incentives of the dominant provider so that supplying the wholesale market at competitive prices is economic.

More importantly, it may be the case that the presence of an ADCo will have an even more profound effect on long-term industry structure. That is to say, ever since the AT&T divestiture, there has been great

80. This result is neither indicated nor required by the model.

discussion about the prospect of legally mandating incumbents to separate structurally their network operations into a separate LoopCo.[81] Structural divestiture, by separating retail and wholesale operations, eliminates the retail market share disincentive to supply the wholesale market, as well as the incentive to sabotage. Regardless of the economic merits of such a structural separation, however, such a notion appears to be a political nonstarter.[82] Given the incumbent's inherent incentive to block entry, as discussed *supra*, it is nonetheless reasonable to inquire whether there could be some mechanism or circumstance where an incumbent would find it more efficient to disaggregate voluntarily its local access.

The presence of an ADCo may just be the catalyst needed to provide an incumbent with the incentive to disaggregate its network facilities from its marketing operations voluntarily. If the ADCo reveals any diseconomies of vertical integration (to the extent they exist), then vertically integrated firms may choose to divest themselves *voluntarily*, because it would be more efficient (i.e., more *profitable*) for them to do so. This voluntary restructuring would be the consequence of an ADCo revealing the presence of diseconomies of scale, scope, or sequence between the retail and wholesale components of the firm.[83] A full analysis of this possibility is

81. *See* Morris, *supra* note 14.

82. For example, some argue that a LoopCo would be economically unsustainable. *See, e.g.*, Jeffrey A. Eisenach et al., *Regulatory Overkill: Pennsylvania's Proposal to Breakup Bell Atlantic*, Progress and Freedom Foundation, Dec. 16, 1999, *at* http://www.pff.org/papucreport.htm. The economics indicate the opposite conclusion, however. First, the LoopCo's costs are sunk, and it has already achieved the scale economics necessary to be successful. As such, it will be established in a market capable of sustaining only a few firms. Second, assuming *arguendo* that there are no other local access facilities (or even a few), it is highly likely that regulators will still impose some sort of price regulation on the LoopCo. As such, it is unclear how a LoopCo would be economically unviable when its operational costs are guaranteed by regulation. Finally, it may turn out that the LoopCo would exceed its regulatory rate of return through the market because divestiture has removed its incentive to discriminate and replaced it with an incentive to sell as much of its product (i.e., local access) to as many potential buyers as it could find. Indeed, if a LoopCo is really such an inefficient business proposition, then why did British Telecom reject offers of $11.4 billion and $25.7 billion respectively for its local access networks from firms who realized the benefit of breaking out the value of BT's assets via a LoopCo? *See* Dan Roberts, *BT Rebuffs $8bn Offer for Lines*, FIN. TIMES, July 30, 2001, § 1, at 19 (quoting potential purchaser as believing that "BT has ignored the potential of its local loop because any ADSL services provided by rival operators compete with its own retail division."); Andrew Ward, *WinLR In $25.7bn Offer for BT Fixed-line Network*, FIN. TIMES, Aug. 5, 2001.

83. *See* George J. Stigler, *The Economics of Information*, 69 J. OF POL. ECON., ISSUE 3 (JUNE 1961) at 213-25; DANIEL F. SPULBER, REGULATION AND MARKETS 119-20 (1989); WILLIAMSON, *supra* note 8.

A classic example of how changing the underlying structure of the market can force firms to "voluntarily" disaggregate can be found in AT&T's spin-off of Lucent Technologies (né Bell Labs). To wit, back when AT&T had a total monopoly over everything short of the spoken word, it was very efficient for AT&T to bring the terminal

beyond the scope of this model and Article, however.

VI. CONCLUSION

The purpose of this Article is to shed some light on the path of future evolution in the competitive telecommunications industry, as well as to explore its somewhat troubled past and present. While it is always desirable to break new ground in research, this analysis will not be particularly groundbreaking to those most familiar with the telecommunications industry. Indeed, this analysis, in many respects, is a formalization of ideas shared among industry insiders for decades.[84] The economics of the telecommunications industry, particularly the supply-side economics, has not changed much over time. Fewness in supply is the rule, not the exception. Instead, fiber optics and other technological innovations remain key drivers of industry structure, notwithstanding the inherent economies of scale and sunk costs of telecommunications networks. As Professors Carl Shapiro and Hal Varian succinctly state in their book *Information Rules*: "*Technology changes. Economic laws do not*."[85] Accordingly, if

equipment sector of the industry "out of the market and into the firm"—i.e., manufacture its terminal equipment on a vertically integrated basis. In the mid-Eighties, however, as long-distance competition was in its infancy, a more forward-looking FCC [realized] that competitors should have more than one source of terminal switching equipment (i.e., AT&T/Bell Labs). As such, through stringent structural regulation such as standard interfaces and plugs, the FCC essentially carved-out the terminal equipment market to allow for competing suppliers.

By the mid-1990's, the market for terminal equipment was flourishing. Not only was there Bell Labs/AT&T, but also other vendors such as Cisco, Siemens and Nortel and a wide variety of other niche technology players as well. As the result of this competition for terminal equipment, the equipment vendor side of AT&T found it was losing customers because, as a corporate entity, it was prohibited from selling to would-be rivals, and the network/marketing side of AT&T was limited only to what Bell Labs came up with. Given this changed market structure, it was now more efficient (i.e., more profitable) for AT&T to disaggregate voluntarily Bell Labs (now Lucent) from AT&T's telephone business (i.e., bring the transaction out of the firm and into the market). In so doing, both firms are better off, as Lucent can now sell to a wide variety of customers, and AT&T now has a choice of competing terminal equipment vendors who distinguish themselves on both a price and/or service quality or technological basis. *See* NAFTEL & SPIWAK, *supra* note 4, at 35.

84. Indeed, the notion of an ADCo was first fleshed out by Jerry B. Duvall in 1998, and has been written about frequently since then. *See* Jerry B. Duvall, *Entry by Electric Utilities Into Regulated Telecommunications Markets: Implications for Public Policy*, Paper Presented Before the Communications Industry Committee, ABA Section of Antitrust Law, Collier, Shannon, Rill & Scott, PLLC, Washington, D.C. (Feb. 6, 1998) *at* http://www.ascent.org/research/phoenix-ctr12.pdf. For sources discussing Duvall's notion, see, for example, Lawrence J. Spiwak, *Utility Entry Into Telecommunications: Exactly How Serious Are We?* (Phoenix Ctr. Policy Paper No. 1, July 1998), *available at* http://www.phoenix-center.org/pcpp/PCPP1Final.pdf; NAFTEL & SPIWAK, *supra* note 4, at 208-09.

85. CARL SHAPIRO & HAL R. VARIAN, INFORMATION RULES 1-2 (1999) (emphasis added).

network-based competition of a highly fragmented nature is desired then competition policy is fighting a losing battle.[86]

In the most general of terms, this Article discusses important economic characteristics of local exchange markets and the firms that participate therein. First, entry into the local exchange market requires large fixed and sunk costs, making entry risky and necessitating scale economies. Consequently, only few local access networks can supply the market. These few local access networks cannot be small, however, because a large market share is required to realize sufficient scale economies to compete effectively with the ILECs and survive.

Secondly, acquiring sufficient market share to realize scale economics may be difficult for entrants that are not wholesale-only firms. Given the substantial scale economies in local exchange networks, it may not be possible for a single carrier to acquire sufficient retail market share in a timely manner to exhaust economies of scale. An integrated firm supplying the wholesale market is conflicted; the integrated firm's retail market share raises the opportunity cost of wholesale supply.

Accordingly, if economies of scale are sufficiently large, then reaching a scale of operation that allows the entrant to compete with the ILEC may be best achieved through a wholesale-only entry strategy—an ADCo. The ADCo can consolidate the consumer demand held by retail CLECs, thereby reducing risk and costs, and expanding output quickly. The disincentives to wholesale supply possessed by the integrated firm, furthermore, do not exist for the ADCo, and therefore the ADCo—unlike the ILEC—has no incentive to sabotage its customers. As a result, the ADCo provides the answer to the central objective of the 1996 Act: that is, while the number of local access networks the market can sustain may be *few*, the wholesale nature of the ADCo nonetheless permits the number of providers of advanced telecommunications products and services to be *many*, which—after all—is the *raison d'être* of market "restructuring."

86. *See, e.g.*, Review of Reg. Requirements for Incumbent LEC Broadband Telecomm. Servs., *Notice of Proposed Rule Making*, CC Docket No. 01-337 (Dec. 20, 2001), *available at* http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-01-360A1.pdf. *But cf.* Lawrence J. Spiwak, *Outside View: The Broadband Shibboleth*, UNITED PRESS INT'L, Dec. 13, 2001, *available at* http://www.upi.com/view.cfm?StoryID=10132001-052454-2749r.

Facilities-based Entry in Local Telecommunications: An Empirical Investigation

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an empirical question cannot be settled by non-empirical arguments.
George Stigler, *The Organization of Industry* (1968), p. 115.

I. Introduction

Over the past decade or so, considerable attention has been directed to the promotion of competition in and the eventual deregulation of the public utilities -- gas, electricity, and local telecommunications. As part of this effort, potential competitors often are given access to elements of the incumbent monopolist's network or plant.[1] Such access is required when particular elements of the incumbent network continue to possess natural monopoly characteristics such as sizeable scale and scope economies.[2] Whether access to these elements is based on the theory of "essential facilities" of antitrust or "unbundled elements" of the Telecommunications Act of 1996, the result is the same: entrants are allowed to use the facilities of the incumbent as their own, and such access is priced at some measure of "cost," typically some variant of forward-looking economic cost.

[1] In some cases, such as local telecommunications, the incumbent continues to provide retail services so that the entrants are both competitors and customers (or "competitor customers") of the incumbent. In others, such as electricity, the incumbent often is prohibited from participating in the market targeted for competition and deregulation (whether upstream or downstream).

[2] Such supply-side characteristics are prevalent in the more geographically local elements of the aforementioned utilities' plant.

A principle difficulty faced by policy makers in this context is which elements of the network are "essential facilities" or satisfy some other governing standard. Economists and lawyers have described numerous problems with both the over- and under-inclusion of elements within the (broad) category of "essential." One frequent concern, particularly in the debate over local exchange telecommunications competition, is that by giving entrants access to parts of the network, those components of the network will never be duplicated and thus subject to the competitive pressure required to deregulate. This substitution effect, commonly couched in terms of a "make-or-buy" decision by the entrant, often lies at the core of the arguments by those calling for a less inclusive policy on what is or is not "essential."

While the "make-or-buy" claim is no doubt superficially appealing, the purpose of this paper is to evaluate this substitution effect in both a theoretically and empirically rigorous way. Theoretically, the presence of a substitution effect is undeniable. However, the theory reveals two other effects, one working with (the *scale effect*) and the other against (the *entry effect*) the substitution effect. Which of the three effects dominates cannot be determined solely by theory. Consequently, an empirical test of the theory is conducted, with the deployment of switching equipment by competitive local exchange carriers ("CLECs") as a case study. This case study is particularly relevant to this issue, given that the entrant's access or lack thereof to the switching function of the local exchange network is the subject of heated debate. The empirical results indicate that for this particular case, the substitution effect is not dominant; restricted access to the "switching element" of the local exchange access, either through higher prices are outright restrictions, will not encourage facilities deployment by entrants.

The empirical findings of this paper provide important guidance for competition policy in the local exchange telecommunications market. Indeed, at the heart of the current telecommunications policy debate lies a key unanswered question: what public policy will best promote facilities-based entry into the local exchange telecommunications marketplace? At the center of the debate is the question as to whether the requirement of the 1996 Telecommunications Act that incumbent local telephone carriers ("ILECs") provide access to their local networks to new entrants ("CLECs," or competitive local exchange carriers), or the requirement that such access be made available at "cost," promotes or deters facilities-based entry.[3] The ILECs encourage policy makers to limit access to their

[3] The Telecommunications Act requires that network access, or unbundled elements ("UNEs") be price at "cost." Cost was to be defined by the Federal Communications Commission, and that agency adopted a total-element, long-run incremental cost ("TELRIC") cost standard.

network and, when access is provided, that it be priced high. Without access to the incumbent's network or with access only at high prices, the ILECs contend that CLECs will be forced to deploy their own facilities and consequently will do so. In other words, the ILECs implicitly assume there exist a strong substitution effect between access to the existing network and the construction of new network. The CLECs, the Federal Communications Commission ("FCC"), and Congress disagree. While the debate over unbundled elements does not lack of propaganda or verve. What *is* missing from the debate is any semblance of a theoretical framework within which to analyze the issues and, perhaps more disturbing, a dearth of empirical evidence.[4] We attempt to address these two shortcomings in this paper.

This paper is organized as follows. In Section II, a two-stage, game-theoretic model of switch deployment is presented. This theoretical analysis, though simple, illustrates the difficulty in finding an unambiguous relationship between network access prices and CLEC facilities deployment. In Section III, the empirical model is described and the results summarized. Concluding comments are provided in Section IV.

II. Conceptual Framework

In order to assess the impact of unbundled network element rates on switch deployment, we develop an economic model in the form of a two-stage game. In Stage 1, firms choose whether or not to enter the market. Then, in Stage 2, firms choose how much switching to self-supply. As is customary with two-stage models, the model is solved backwards so that the first decision to evaluate is how a firm selects its optimal investment in switching, S^*, given that it enters in Stage 1. For simplicity, it is assumed that firms are symmetric *ex ante*, but not *ex post*, and that entry does not affect the retail margin.

TELRIC is a forward-looking methodology, where costs are based on the most efficient, currently deployed technology.

4 Two empirical studies address the impact of the FCC's restriction on unbundled switching in the largest metropolitan statistical areas. See Z-Tel Policy Papers No. 3 (*An Empirical Exploration of the Unbundled Local Switching Restriction*) and No. 4 (*Does Unbundling Really Discourage Facilities-Based Entry? An Econometric Examination of the Unbundled Switching Restriction*). Both papers are available for download at www.z-tel.com, in the investment information section. Neither of these papers addresses, however, the question of facilities-deployment and network access prices.

The model takes the point of view of the CLEC and evaluates the CLEC's decision whether or not to self-provide local switching. In other words, the model assumes that this CLEC entrant decides on its switch investment prior to knowing how many customers it will have (i.e., prior to entry).[5] Thus, there is an uncertainty component to the model, and this uncertainty relates to demand. Upon entering the market, the CLEC provides service to end-users using unbundled loops purchased from the ILEC along with either unbundled local switching purchased from the ILEC or its own, self-supplied local switching.

The variables of the model include.

- I = the number of firms that enter;
- $N(I)$ = expected number of customers a single firm acquires and serves upon entry;
- $\lambda N(I)$ = actual number of customers;
- λ = random variable, $E(\lambda) = 1$, $\lambda \in [0, \infty +)$ with probability density function $f(\lambda)$ and cumulative density function $F(\lambda)$;
- S = number of customers firm can service with its own switches;
- $e \cdot S$ = cost of firm switches (a sunk cost), where e is the price per customer served by self-supplied switching;
- P_l = regulated price of an unbundled loop;
- P_s = regulated price of unbundled switching;
- c = other per customer retail costs;
- R = revenue per end-user customer;
- M_a = margin with self-supplied switching $(R - P_l - c)$;
- M_b = margin with unbundled switching $(R - P_l - P_s - c)$, where $M_a > M_b$.

Prior to entry, firms expect to acquire and serve N customers. However, the customer base is only an expectation, with actual customers equaling λN (where λ is a random variable). If $\lambda N < S$, actual demand is less than switching capacity,

5 This assumption is rationale, because network design and configuration, staffing requirements, financial and capital requirements, and operational experience vary considerably between CLECs that self-provide local switching capacity.

the entrant uses its own switching exclusively. This level of demand occurs with probability $F(S/N)$.

In this case, the profit of the entrant is

$$\pi = \lambda N \cdot M_a - e \cdot S \,. \tag{1}$$

which is simply the margin on the actual customer base minus switch investment. Alternately, if $\lambda N > S$, the entrant uses both its own switching capacity as well as purchasing unbundled switching from the ILEC. This level of demand occurs with probability $[1 - F(S/N)]$. In this case, the profit of the entrant is

$$\pi = S \cdot M_a + (\lambda N - S)M_b - e \cdot S \,. \tag{2}$$

Note that there can be other sunk entry costs in addition to switching investment, but the presence of such costs does not alter the analysis. For expositional convenience, we ignore such costs.

Expected profit as a function of S, N, P_l, and P_s is

$$E\pi = \int_0^{S/N} \lambda f(\lambda)d\lambda \cdot N \cdot M_a + \int_{S/N}^{\bar{}} \lambda f(\lambda)d\lambda \cdot NM_b + (1 - F(S/N)) \cdot S \cdot (M_a - M_b) - e \cdot S \,. \tag{3}$$

To find the optimal level of switch investment, S^*, the first order condition of Equation (3) with respect to S is needed:

$$\frac{\partial E\pi}{\partial S} = (1 - F(S/N)) \cdot (M_a - M_b) - e = 0 \,. \tag{4}$$

The second order condition is

$$\frac{\partial E\pi}{\partial S} = -f(S/N) \cdot (1/N) \cdot (M_a - M_b) < 0 \tag{5}$$

indicating that S^* is a maximum.

Useful comparative static results include

$$\frac{\partial^2 E\pi}{\partial S \partial N} \quad [illegible] \frac{S}{N^2} [illegible]$$

indicating that the larger the number of expected customers, the more the entrant will self-supply switching.[*] Defining π at S^* as π^*, we have:

$$\frac{\partial E\pi^*}{\partial N} = \int_0^{S/N} \lambda f(\lambda)d\lambda \cdot N \cdot M_a + \int_{S/N}^{\bar{}} \lambda f(\lambda)d\lambda \cdot NM_b > 0 \,, \tag{7}$$

$$\frac{\partial E\pi^*}{\partial P_s} = N\left[(1 - F(S/N)) \cdot S/N - \int_{S/N}^{\bar{}} \lambda f(\lambda)d\lambda\right] < 0 \,, \tag{8}$$

and,

$$\frac{\partial E\pi^*}{\partial P_l} = -N < 0 \,. \tag{9}$$

Equation (7) indicates that an increase in the customer base increases expected profits. Equation (8) and Equation (9) imply that higher element rates, whether loops or switching, reduce expected profits.

Turning to the question of switches deployed in the market, assume that all firms pick the same S^* *ex ante*, but *ex post* the demands differ randomly for firms. Market demand is assumed to be constant and insensitive to the allocation of demand among firms. Given R, P_l, P_s, e, and N, each firm selects S^*. Equilibrium profit for each firm, π^*, is assumed to be zero. This assumption allows us to solve for $\tilde{N}$, the "minimum necessary market size." The number of firms that enter, I, depends on this $\tilde{N}$ (*i.e.*, $I = I(\tilde{N})$), where $I' < 0$ – the larger the market share needed to break even, the fewer firms enter in equilibrium. The optimal level of switch deployment for any given firm is $S^* = S^*(P_l, P_s, \tilde{N})$.

If each firm deploys S^* switching, then the total amount of CLEC switching is given by

[*] It is plain to see here how the capacity constraints of the manual, hot-cut process will impede CLEC switch deployment.

$$S = \tilde{N}(N) \cdot S^* \qquad (10)$$

which states that total switching capacity deployed is simply the number of firms multiplied by average switching capacity. The response of switching deployed to a change in the loop rate is

$$\frac{d\bar{S}}{dP_l} = I' \cdot \frac{\partial \tilde{N}}{\partial P_l} \cdot S^* + I \left[\frac{\partial S^*}{\partial P_l} + \frac{\partial S^*}{\partial N} \frac{\partial \tilde{N}}{\partial P_l} \right] \qquad (11)$$

but $dS^*/dP_l = 0$, so

$$\frac{d\bar{S}}{dP_l} = \frac{\partial \tilde{N}}{\partial P_l} \left[I' S^* + I \cdot \frac{\partial S^*}{\partial N} \right]. \qquad (12)$$

All the right-hand side terms in Equation (12) are positive except for I'. Thus, the sign on $d\bar{S}/dP_l$ is ambiguous. Equation (12) reveals the two important, and contrary, effects of changes in the loop rate on switch deployment. First, as P_l rises, the per-customer margin declines. When customers become less profitable, the entrant needs more customers to breakeven ($d\tilde{N}/dP_l > 0$), and an increase in customers leads to increased switch deployment. This effect is called the scale effect.

The second effect is called the entry effect. From the scale effect, we know that a change in the loop price alters the scale of the firm. As the market share required to profitably enter rises due an increase in the loop rate, fewer firms can profitably enter ($I' < 0$). A reduction in the number of firms reduces total switch deployment. The source of the ambiguity is, therefore, concerns whether the scale effect dominates the entry effect, or vice versa.

While the scale and entry effects arise when considering the effects of the switching price on total switches, an additional effect is also present. A change in the switching rate on total switches is

$$\frac{d\bar{S}}{dP_s} = \frac{\partial \tilde{N}}{\partial P_s} \left[I' S^* + I \cdot \frac{\partial S^*}{\partial N} \right] + I \cdot \frac{dS^*}{dP_s}. \qquad (13)$$

The scale and entry effects are both present, but there is an additional term on the right-hand side not present in Equation (12). This term measures the *substitution effect*. The substitution effect accounts for the substitution between self-supplied switching and purchased switching. As the price of purchased

switching declines, the incentive to self-supply switching declines ($dS^*/dP_s > 0$) and vice versa. Clearly, the substitution effect is only one of three potential effects arising from a change in switching rates. The sign of Equation (13), as with Equation (12), is ambiguous. Because the theory offers no unambiguous finding with respect to unbundled switching rates and switch deployment, the impact of changes in the switching rates on switch deployment is an empirical question. It is to that empirical question to which we now turn.

III. Econometric Model

This empirical model focuses on the relationship between CLEC deployed local exchange switching equipment and the rates for unbundled local loops and unbundled local switching. The relationship between element rates and switching facilities deployment is particularly interesting since switch deployment is the primary focus of the ILECs' policy agenda. Furthermore, local switching is fertile ground for empirical analysis because state-level data on CLEC deployment of local switching equipment is available, and because UNE prices are established on a state-by-state basis, providing sufficient variability in the data for econometric analysis. In addition, the FCC has limited the availability of unbundled local switching in certain areas of the Top 50 metropolitan statistical areas. Thus, it is possible to assess how this lack of access has influenced switch deployment.

From the Local Exchange Routing Guide ("LERG"), we compute the number of CLEC switches deployed (S) between April 2000 and October 2001 in each of the fifty states and the District of Columbia. Also computed is the number of CLEC switches deployed between January 1999 and April 2000 ($S99$). Explanatory variables include the price of local loops (P_L), the price of unbundled local switching (P_S), market size as measured by the number of Bell Company access lines in the state (*LINES*), and average local service revenue per-line in the state (*RETAIL*). In addition, the variable *RESTRICT* measures the percent of population in those metropolitan statistical areas in each state where the availability of unbundled local switching is limited.

1. DATA

As previously mentioned, CLEC switch deployment data is provided by the LERG (January 1999, April 2000, and October 2001).[7] Bell Company access lines by state are provided by ARMIS From 43-04 (2000 data).[8] Retail price is measured as average revenue per line and this data is provided by the FCC's universal service reports.[9] The percent of population for each state in a restricted, Top 50 MSA is computed using Census data.[10]

Unbundled element rates for loops and unbundled switching are based on state tariffs and interconnection agreements between the ILEC and CLECs. The computation of element costs is both a complex and enormous undertaking. This undertaking was avoided, fortunately, by acquiring summary data on network access prices from a CLEC serving the vast majority of the U.S. market.[11] Loop and switching cost data was provided for 39 states. To protect the confidentiality of the data, the price data is normalized to 1.00 by dividing the series by their respective means. This adjustment to the data has no material impact on the regression results, affecting on the constant term. Because the other explanatory variables are available for all states, these 39 states make up the final sample.

2. RESULTS

The econometric equation describing switch deployment is

$$S = \beta_0 + \beta_1 P_L + \beta_2 P_S + \beta_3 LINES + \beta_4 RETAIL + \beta_5 RESTRICT + \varepsilon \qquad (14)$$

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[7] CLEC switches are defined as follows: COC_TYPE = "EOC"; CATEGORY = "CLEC", "I_reseller", or "CAP"; minimum values for NPA and NXX = "Not Null". The CATEGORY field is found in LERG 1, whereas the remaining fields are found in LERG 6. The two tables are linked using the field "OCN."

[8] The ARMIS data is available online at www.fcc.gov/ccb/armis.

[9] Federal Communications Commission, State-by-State Telephone Revenues and Universal Service Data, April 2001, Table 5.

[10] For MSAs that cross state lines, the population is allocated in proportion to the largest cities within the MSA. Because the FCC's switching restriction did not apply in New York and Texas, *RESTRICT* was set equal to zero for these states.

[11] The data was provided by Z-Tel Communications, in Tampa, Florida. Z-Tel provides local exchange service using the UNE-Platform (local loops plus local switching/transport) in ___ states. Switching costs include local switching and transport, as well as switch related charges such as the daily usage file (usage statistics required for billing).

where the βs are the estimated coefficients and ε is the econometric disturbance term. The dependent variable (S) is count data (i.e., the data has only discrete, so we employ the Negative Binomial Regression, which a commonly used alternative to linear least squares regression for count data.[12] Unlike the Poisson regression, which is another popular regression technique for count data, the negative binomial regression does not require that the conditional mean of the data equal the conditional variance. If this assumption is incorrect (i.e., there is *overdispersion* in the data), then the Poisson estimates are invalid. The estimates of the Negative Binomial Regression, however, are not. Further, if overdispersion is not present, then the estimates of the Negative Binomial Regression are identical to those of the Poisson regression.

As a product of the Negative Binomial Regression, and "overdispersion" parameter, α, is estimated. The value and statistical significance of this estimated parameter indicates whether or not the Negative Binomial regression is preferred to the Poisson regression, because a non-zero value of the overdispersion parameter indicates the restrictive assumptions of the Poisson regression are inappropriate. If the estimated overdispersion parameter is zero (statistically insignificant), then the Negative Binomial regression is identical to the Poisson regression. Our estimates indicate that overdispersion is present in the data, so the Negative Binomial Regression is the preferred estimation technique for Equation (14).

The results of the Negative Binomial Regression are provided in Table 1.[13] Two models are estimated. In Model (1), the dependent variable is measured as the number of CLEC switches deployed in each state between April 2000 and October 2001, during which time the restriction on access to unbundled switching applied.[14] Model (2) has a dependent variable measuring the number of CLEC switches deployed between January 1999 and April 2000, a period prior to the ULS restriction. This second model is estimated primarily to validate the specification of *RESTRICT*. If our measure of the switching restriction is statistically significant during a period in which the restriction did not apply, it is

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[12] For a technical discussion of Negative Binomial and Poisson regressions, see A. Colin Cameron and Pravin K. Trivedi, *Regression Analysis of Count Data* (1998), Ch. 3.

[13] Both models were estimated using ordinary least squares. The results were not materially affected, though the estimates of the Negative Binomial Regression were more efficient. For the OLS regressions, the Ramsey RESET Test of "no specification error" could not be rejected for either equation.

[14] The restriction continues to apply.

possible that *RESTRICT* also is measuring factors other than the switching restriction.

The likelihood ratio index, a measure of goodness-of-fit, is just above 0.74 for both models.[15] The overdispersion parameter, α, is statistically significant for both models, indicating that the Negative Binomial Regression is preferred to the Poisson regression.

For Model (1), all explanatory variables are statistically significant at the 5% level or better. As expected, larger markets have more CLEC switch entry; the coefficient on *LINES* is positive and highly statistically significant (t = 3.60). Note that the relationship between access lines and CLEC switches is less than proportional indicating that a 10% increase in lines results in only a 5% increase in switch deployment.[16] Higher revenue per access line also leads to more switch deployment (*RETAIL* is statistically significant and positive). The positive (and nearly statistically significant) sign on *RETAIL* was expected somewhat because higher expected revenues increase the expected profit of entry (ceteris paribus).[17]

Of particular interest are the effects of UNE rates (P_L, P_S) and the unbundled switching restriction (RESTRICT) on CLEC switch deployment. No a priori expectation regarding the effect of the price for unbundled loops or switching on switch deployment was made, given that the theoretical model allows for both positive and negative values (and perhaps a zero value). The regression results indicate, however, that higher loop rates decrease switch deployment: a negative and statistically significant sign on P_L is estimated (with t-statistic 2.64). The empirical model, by the negative sign on P_L, indicates that the entry effect dominates the scale effect. We cannot reject that the estimated coefficient on P_L (-0.95) is equal to -1.00 (via the Wald Test). Thus, assuming a unitary elasticity between switch deployment and loop price is reasonable (i.e., a 10% increase in the loop rate decreases CLEC switch deployment by about 10%).

The theoretical ambiguity between the price for unbundled switching and switch deployment is resolved by the empirical model. The estimated coefficient on the

[15] For a discussion of goodness-of-fit measures for non-linear regressions, see Cameron and Trivedi, pp. 151-8.

[16] A consistent result is found in *Does Unbundling Really Discourage Facilities-Based Entry? An Econometric Examination of the Unbundled Switching Restriction*, Z-Tel Policy Paper No. 4 (February 2002).

[17] However, existing retail prices may not be a reliable estimate of post-entry prices, so such prices may be ignored by entrants.

price of local switching (P_S) is negative and statistically significant (the t statistic is 2.18). The estimated coefficient indicates an elasticity of -0.50, so a 10% increase in the UTS rate decreases CLEC switch deployment by 5%. The negative coefficient indicates that, on average, the substitution of unbundled switching for switch deployment is not the dominant factor at current UNE rates. The entry effect dominates both the scale and substitution effects. Higher switching rates reduce CLEC switch deployment, on average.

Finally, the sign on *RESTRICT* is negative and statistically significant (the t statistics is 1.96), indicating that the restriction has impeded rather than encouraged switch deployment. At the sample means for the other variables, the elimination of the switching restriction in states where the restriction applies would increase CLEC switching capacity by 44% in those states, on average.[18] These regression results suggest that the switching restriction has been a major policy failure, significantly deterring switch deployment.[19]

We recognize that given the specification of *RESTRICT*, there is the potential that the variable captures variations in switch deployment across states based factors other than the switching restriction. However, *RESTRICT* has no effect on switch deployment between January 1999 and April 2000 (Model 2), the period prior to the implementation of the restriction. Because the percent of population in a restricted, Top 50 MSA has no effect prior to the implementation of the restriction, but a negative and statistically significant effect after the restriction, it is reasonable to conclude that the regression properly captures the effect of the restriction. Only market size (*LINES*) and the constant term are statistically significant in Model 2.

IV. Conclusion

Profit maximizing firms participating in a market economy make "make-or-buy" decisions everyday. While these decisions are of interest to economists in determining what may be an efficient organization of the firm, the "make-or-buy" decision is evaluated differently when the ability to "buy" is mandated and governed by regulation rather than the market, and the ability to "make" is limited substantially by various entry barriers. Such scenarios are commonplace

[18] The mean of *RESTRICT* for states where the restriction applies is 46%.

[19] Earlier econometric research on the switching restriction indicates that the overall level of CLEC penetration is reduced by the switching restriction. See *An Empirical Exploration of the Unbundled Local Switching Restriction*, Z-Tel Policy Paper No. 3 (Updated February 2002).

in the competition policy for the regulated utilities including electricity, gas, and telecommunications.

One common concern in such scenarios is when the ability to "buy" substantially offsets the incentive to "make." In this paper, we evaluated both theoretically and empirically the relationship between "make" and "buy." In our particular construct, where self-supplied and purchased inputs may serve as complements, three sometimes conflicting effects are relevant to the "make-or-buy" decision, of which the substitution effect is only one. Our empirical example considers the deployment of switching facilities by entrants to the local exchange telecommunications markets, and these empirics indicate that the substitution effect is not dominant in this particular case. Of course, the empirical example chosen for our analysis is not necessarily indicative of any other particular case. However, our findings do support the general notion that the substitution effect is not the only relevant consideration, either theoretical or empirical, for policy makers in selecting what inputs to make available to entrants when promoting competition in the utility industries.

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Table [illegible] Negative Binomial Regression Results and Descriptive Statistics

(N = 39)

Variable	Dependent Variable = S Coefficient (t-Stat)	Dependent Variable = S99 Coefficient (t-Stat)	Mean (St. Dev)
Constant	-10.169 (-3.60)[a]	-9.598 (-4.19)[a]	--
ln(LOOP)	-0.953 (-2.64)[a]	0.387 (1.22)	1.00 0.29
ln(ULS)	-0.487 (-2.18)[a]	-0.006 (-0.03)	1.00 0.49
ln(LINES)	0.490 (3.68)[a]	0.753 (6.93)[a]	3,744,347 (4,157,467)
ln(ARPL)	1.917 (2.59)[a]	0.568 (0.93)	33.95 (4.70)
RESTRICT	-0.798 (-1.96)[a]	0.010 (0.03)	0.30 (0.28)
α	0.268 (5.43)[a]	0.178 (6.46)[a]	
Pseudo R^2	0.76[c]	0.74[c]	
S			46.72 (41.59)
S99			39.31 (35.34)

[a] Statistically Significant at the 5% level or better.
[b] Statistically Significant at the 10% level or better.
[c] Pseudo-R2 is computed using the likelihood ratio index.

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Phoenix Center Policy Paper Number 14:

Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network

T. Randolph Beard and George S. Ford

(September 2002)

Phoenix Center Policy Paper No. 14

Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network

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Abstract: In this paper, we estimate demand curves for unbundled loops sold by incumbent local exchange telecommunications carriers to their retail rivals. Of primary interest are the cross-price effects between unbundled loops purchased with and without unbundled switching. As expected, we find downward-sloping demand curves for unbundled elements, with own-price elasticities in the elastic region of demand. Interestingly, however, we also find no evidence of positive cross-price elasticities between alternative modes of unbundled element entry.

TABLE OF CONTENTS:

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I. Introduction

The unbundling provisions of the Telecommunications Act of 1996 are designed to promote competition in local exchange markets. Six years after passage, the legal and policy debate over these provisions continues to rage without resolution. One question that lies at the heart of the debate is whether unbundling (both as implemented and in general) reduces the demand available to facilities-based entrants, thereby deterring competitive local exchange carriers ("CLECs") from investing in their own telecommunications facilities? This paper provides evidence and analysis regarding this question by estimating demand curves for unbundled loops leased with and without unbundled switching, and adds to the relatively sparse body of empirical guidance on the subject. To our knowledge, this paper is the first attempt to estimate the own-price and cross-price elasticities of demand for unbundled loops and switching.

With the cross-price elasticity of demand of loops purchased without unbundled switching, the question of substitution among alternative entry modes (*i.e.*, with and without switching) can be evaluated in a manner consistent with standard antitrust analysis of market definition. A high, positive cross-price elasticity indicates that, for a small increase in the price of one product (switching), the quantity demanded of some other product (loops without switching) is substantially increased. If the cross-price elasticity is negative and large, then a price increase for one product will reduce the demand for the other. In the case of high cross-price elasticity (positive or negative), the courts have frequently concluded that the two goods or services are in the same market.[1] Separate markets for the goods or services are indicated if the cross-price effects are low. Thus, whether or not loops leased with and without unbundled switching are in the "same market" is addressed in this paper, using a method familiar to both antitrust and regulation.[2]

Our findings are summarized as follows.

[1] AMERICAN BAR ASSOCIATION ANTITRUST SECTION, ANTITRUST LAW DEVELOPMENTS (3d ed. 1992), Vol. I, at 282-93.

[2] *Id.; see also, e.g.*, In re Review of the Commission's Regulations Governing Television Broadcasting, *Further Notice of Proposed Rulemaking*, 10 FCC Rcd 3524 (1995), available at http://ftp.fcc.gov/Bureaus/Mass_Media/Notices/fcc94322.txt. .

1) The demand curves for unbundled loops and switching slope downward, and have elasticities in the elastic region of demand.

2) Cross-price elasticities are not distinguishable from zero implying that mandated access is not serving as a substitute for CLEC deployed switching; and

3) Finally, a simple test of "impairment" is conducted, and unbundled switching is found to satisfy the standard set forth in the Act.

II. Empirical Model

The purpose of this empirical analysis is to estimate reasonable approximations of the ordinary demand for unbundled loops purchased with or without unbundled switching.[3] We first define the variables in our model. The total number of unbundled loops purchased in a state for the provision of local telephone service (Q_T) includes the quantity of loops purchased without unbundled switching (Q_L; UNE-Loop) and with unbundled switching (Q_S; UNE-Platform), so that $Q_T = Q_L + Q_S$ (the subscript S is used for the Platform to indicate that the Platform CLEC purchases "switching" with the loop). The quantities Q_L and Q_S are our dependent variables, and the demand elasticities for Q_T are easily computed from the econometric estimates.

GENERALLY, THE ESTIMATED DEMAND CURVES FOR UNBUNDLED LOOPS ARE

$$\ln Q_L = \alpha_0 + \alpha_1 \ln P_L + \alpha_2 \ln P_S + \sum_{j=1}^{n} \alpha_j Z + \varepsilon_L \tag{1}$$

$$\ln Q_S = \beta_0 + \beta_1 \ln P_L + \beta_2 \ln P_S + \sum_{j=1}^{n} \beta_j Z + \varepsilon_S \tag{2}$$

where P_L is the loop price, P_S is the price for unbundled switching, the vector Z represents n other demand-relevant factors that influence the demand for

[3] In conjunction with unbundled switching, UNE-Platform CLECs purchase unbundled transport. Thus, we include transport in unbundled switching.

loops of both types, and ε_L and ε_S are econometric error terms that measure the unobserved determinates of loop demand. The price of unbundled switching is included in both demand equations, measuring cross-price elasticity in Equation (1) and own-price elasticity in Equation (2). All variables are measured at the state level, and only Regional Bell Companies are represented in the sample. Descriptive statistics and variable descriptions and sources are provided in Table 1.

A. *Prices and Elasticities*

Given the specification of Equations (1) and (2), own-price elasticities of demand ($\eta_{ii} = \partial Q_i/\partial P_i \times P_i/Q_i$) are measured by coefficients α_1, β_1, and β_2. The cross-price elasticity ($\eta_{ij} = \partial Q_i/\partial P_j \times P_j/Q_i$) is measured by α_2. Because demand curves slope downward, we expect both α_1 and β_1 to be negative, and the log-log specification implies that these coefficients measure the (constant) own-price elasticity of demand for unbundled loops of each type. Joint consumption of loops and switching in the loop-switching combination implies that β_2 measures the own-price elasticity of demand for unbundled switching. Additionally, this joint consumption of the loop and switching elements for the UNE-Platform suggests that the quantity effect on the demand for loop-switching combinations of a \$1.00 price increase of either P_L or P_S should be roughly equal. This equality implies that $\beta_1/w = \beta_2/(1 - w)$, where w is the loop's share of total combination cost $[P_L/(P_L + P_S)]$. The Wald Test can be used to test whether this equality (*i.e.*, restriction) holds.

The price of unbundled switching P_S is a cross-price for the demand for loops purchased without switching, and the sign of α_2 will indicate the demand relationship of unbundled and self-supplied switching. If a decrease in the price of unbundled switching leads to a substitution of unbundled switching for self-supplied switching, then α_2 will be positive. A negative sign on α_2, alternatively, suggests that unbundled and self-supplied switching are complements because a decrease in the price for switching increases the demand for loops purchased without switching.[4] If α_2 is not different from zero, then the entry modes are unrelated in demand.

[4] Beard *et al.* present a formal, theoretical model illustrating the complementary and substitution relationships that may exist between unbundled switching and self-supplied switching. Beard, T. Randolph, George S. Ford & Thomas W. Koutsky, *Facilities-based Entry in Local Telecommunications: An Empirical Investigation* (unpublished manuscript, available at (Footnote Continued. . . .)

B. *Other Variables*

Other variables in the demand equation (making up the vector Z) include the total demand for the final good (local service) measured as the total local service revenues of the Bell Company in the state (*SIZE*). This variable is included in the model because a loop demand curve is a derived demand. A priori expectations are that demand is positively related to market size. Given the specification of the model (log-log), an estimated coefficient on *SIZE* less (greater) than 1.00 indicates that demand increases less (greater) than proportionately to market size.

The mix of total demand between residential and business customers also may influence Loop demand. Two explanatory variables are included to measure the mix of demand: 1) the ratio of business-to-residential retail rates (*RESRAT*), and 2) the percent of total, analog, switched access lines that are used to serve residential consumers (*RESSHR*). The two demand-mix variables, *RESRAT* and *RESSHR*, both measure the extent to which market demand is residential in nature. Generally, unbundled loops and self-supplied switching are used to serve businesses, whereas unbundled loop-switching combinations are used to serve residential and small business customers. So, it is reasonable to expect negative signs on both variables in the Q_L equation, and positive signs in the Q_S equation.[5]

Both the New York and Texas public service commissions have exhibited leadership in promoting competition, and competitor penetration in these two states is considerably higher than average. Thus, a dummy variable that equals one for New York and Texas (*DNYTX*), zero otherwise, is included in the model. New York and Texas are the leaders in promoting competition via unbundled elements, so positive signs are expected on *DNYTX*.

The Bells' ability to provide long distance telecommunications service may influence demand, so we include a dummy variable for states in which the Bell Companies have received 271 approval (D271). Both New York and Texas have

http://www.telepolicy.com). In that study, the effects of the availability and price of unbundled switching on number of CLEC deployed switching entities were evaluated using econometric methods. The study found that higher switching prices and unrestricted access to switching led to more, not less, switch deployment by CLECs.

[5] At current CLEC penetration rates (less than 10% on average), it is not clear that factors relevant at the margin (such as residential share and prices) will impact current demand.

271 approval, so the 271 dummy variable measures the influence of 271 approval absent the leadership effect of these two states. No *a priori* expectation is made about 271 status (*D271*), and it is important to keep in mind that the dummy variable *D271* measures the effect of 271 approval once the "leadership effect" of New York and Texas (both 271 approved states) is taken into account.[6]

A dummy variable indicating states with high non-recurring charges (*DNRC*), and the percent of the state's population density (*METPOP*), are both included as additional regressors.[7] The variable *METPOP* is measured as the percent of a state's population living in metropolitan areas. Non-recurring charges are sunk costs and, consequently, deter entry, so a negative sign on *DNRC* is expected.[8] Population density (*METPOP*) is expected to positively affect demand for unbundled loops purchased without switching due to density economies for self-supplied switching, but no a priori expectation is made with respect to the variable's effect on loop-switching combinations.

Finally, since our data was collected in June and December of 2001, a dummy variable indicating the "as of" date of the data (DSAMPLE) is included as a regressor. A positive and statistically significant coefficient indicates that, on average, demand increased over the six-month period between June 2001 and December 2001.

III. Results

The two equations are estimated (as a system) by weighted least squares.[9] Results are summarized in Table 2. Due to limitations on the availability of data

[6] The loop penetration rates (total loops divided by total access lines) in New York and Texas are much higher than average (about 19% for these two states to the average of 5% for the others), and this difference is statistically significant (t statistic = 7.56).

[7] For every unbundled loop or loop-switching combination leased from the incumbent LEC, the CLEC must pay the ILEC a non-recurring charge ("NRC") to cover the labor costs of the migration (ordering and provisioning). A high NRC is defined to be an NRC exceeding $50.

[8] We do not have data on the non-recurring charges for loops purchased without switching. We assume that the loop-switching non-recurring charge is highly correlated with the loop non-recurring charge. Depending on the correlation, the variance of *DNRC* in the Q_L equation may be large (implying a low t-statistic).

[9] By estimating as a system using weighted least squares, the estimates are more efficient relative to ordinary least squares estimates of the individual equations because the procedure increases the degrees of freedom and corrects for heteroskedastic disturbances. *See* PINDYCK, ROBERT S., & DANIEL L. RUBINFELD, ECONOMETRIC MODELS & ECONOMIC FORECASTS (3rd ed. 1991). Because there are no cross-equation restrictions, the estimated parameters are identical to single-
(Footnote Continued. . . .)

for prices and quantities, the final sample consists of 134 system observations or 67 (balanced) observations for each equation. The R^2 of Equation (1) is about 0.85 and Equation (2) is 0.77, indicating that a large amount of the variation of loop demand of both types is explained by the regressions.

Econometric specification errors such as omitted variables, endogenous explanatory variables, errors in measurement, and an incorrect functional form can each cause least-squares estimates to be biased, inconsistent, and inefficient.[10] The RESET test is a rather general test of specification error, and is capable of detecting all of the specification problems listed above (Ramsey 1969), and the test is particularly sensitive to omitted variables and incorrect functional form. The null hypothesis for RESET is 'no specification error,' so specification error is indicated if the null-hypothesis is rejected. The RESET F-statistics are provided in Table 2, and neither test statistic is statistically significant even at the 10% level, so there is no evidence of specification error (*i.e.*, null-hypothesis of "no specification error" cannot be rejected at standard significance levels). Accordingly, we can be reasonably certain that our model does not suffer from these important specification errors.

A. *Price Elasticities*

1. *Loops*

As indicated by theory, the demand curves for unbundled loops of both types slope downward, with an elasticity of about -1.7 for both Q_L (α_1) and Q_S (β_1).[11] Both elasticities are in the elastic region of demand, indicating that quantity demanded responds more than proportionately to any given percentage change in price. A 10% increase in the loop price will decrease quantity demanded for

equation ordinary least squares estimation. However, the standard errors of the two procedures are not the same.

[10] This class of error violates the least squares assumption of a null mean for the theoretical disturbance vector. The RESET Test is valid only for least-squares regressions. Ramsey's RESET Test is performed by including as regressors the powers of the predicted values of the regression. The joint significance of these additional regressors is evaluated, and the null hypothesis of "no specification error" is rejected if the RESET F-Statistic exceeds the critical value (*i.e.*, the test of the joint restriction that all of the additional coefficients equal zero is statistically significant).

[11] James Eisner and Dale Lehman (2001) surprisingly conclude that the demand curve for unbundled loops slopes upward. Eisner, James & Dale Lehman, *Regulatory Behavior & Competitive Entry* (unpublished manuscript, available at http://www.sbc.com/public_affairs/long_distance_news/california/).

each type of loop by about 17%. We cannot reject the [illegible] elasticities are equal using the Wald Test (χ^2 = 0.01). Thus, our estimates suggest that it is reasonable to conclude that an increase or decrease in the loop rate for unbundled elements has an equivalent effect on all forms of loop purchases, and that the percentage quantity response of both quantities will exceed the percentage price change.

The effects of prices on the total quantity of competitive services provided using unbundled loops can be computed from the estimated coefficients of the demand equations. In fact, the own-price demand elasticity for total loops (Q_T) is simply the weighted average of the two elasticities measured by α_1 and β_1, because in our sample, Q_L/Q_T is approximately equal to 0.50. The simple average of the two own-price elasticities is -1.7, and this value measures the total, own-price elasticity of demand for unbundled loops of both types. Across loops of all types, a 10% increase in the price of an unbundled loop alone will decrease the quantity of loops sold by about 17%, all else being equal.

2. *Switching*

Turning to the price for unbundled switching (P_S), we first consider the own-price effect of switching on the demand for loop-switching combinations (Eq. 2). The estimated own-price elasticity of demand for unbundled switching is -1.12, which indicates that a 10% change in price produces an 11% change in quantity demanded. The estimated elasticity is statistically significant at better than the 1% level (t statistic -3.59). As previously mentioned, for loop-switching combinations, the loop and switching components are purchased jointly. This joint consumption suggests that the effect on quantity demanded of a \$1.00 price increase of either P_L or P_S should be roughly equal, and the Wald Test indicates that the restriction $\beta_1/w = \beta_2/(1 - w)$ is valid.[12] This finding implies that it is the total price for the loop-switching combination that matters, not the individual prices for each component.[13]

The price elasticity of demand of total loops with respect to P_S is -0.51. Thus, a 10% increase in the price of unbundled switching will reduce the total amount

[12] The adjusted elasticities are -3.06 and -2.44, and the test of equality produces a χ^2 statistic of 0.27. We note that the hypothesis that $\beta_1 = \beta_2$ cannot be rejected.

[13] For a recent paper estimating the own-price elasticity of demand of loop-switching combinations, see Robert B. Ekelund Jr. & George S. Ford, *Preliminary Evidence on the Demand for Unbundled Elements* (unpublished manuscript, available at http://www.telepolicy.com).

of competition provided over unbundled loops by 5%. This demand elasticity is statistically significant at better than the 5% significance level (χ^2 = 8.27)

3. *Unbundled Switching and UNE-Loop*

Perhaps the most policy-relevant finding of the econometric model is that the cross-price elasticity of Q_L with respect to P_S (0.10), though positive and small (0.10), is not statistically different from zero (t statistic = 0.58). Thus, our results imply that the two modes of entry (with or without unbundled switching) are unrelated in demand, being neither substitutes nor complements, all else being equal. The policy implication is clear: at current prices, unbundled switching is not a substitute for self-supplied switching, and increases in the switching price will not increase the quantity of loops serving end users with CLEC-deployed switching equipment.[14]

B. *Other Variables*

Market size (*SIZE*), which measures total expenditures for local service, increases the demand for loops of both types. The coefficients are less than 1.00, so the increase in demand is less than proportionate to the increase in market size.[15] Demand for unbundled loop-switching combinations, other things constant, is not higher in markets where demand is more intensely residential; both *RESRAT* and *RESSHR* are statistically insignificant in the Q_S equation. Nor does the residential-business mix of demand appear to influence the demand for unbundled loops purchased without switching.[16]

New York and Texas, two leading states in the promotion of competition in local exchange markets, have a higher demand for loops leased with and without unbundled switching, and these effects are statistically significant, though statistical significance is much higher in the Q_S equation. Once the higher

[14] The recent study by Beard *et al.* found that a lower switching price increases the count of CLEC deployed switching equipment. *See Beard et al.*, supra n.4. Our present finding suggests that the available demand to switch-based CLECs in not reduced by lower switching prices. Thus, lower switching prices unambiguously encourage facilities deployment.

[15] Statistically, we cannot reject the hypothesis that the coefficients on *SIZE* are equal across equations.

[16] In contrast to the result on *RESRAT*, Ros and McDermott found that higher business rates relative to residential rates impedes facilities-based entry by CLECs. *See* Agustin J. Ros & Karl McDermitt, *Are Residential Local Exchange Prices Too Low?*, *in* EXPANDING COMPETITION IN REGULATED INDUSTRIES (Michael A. Crew ed., Kluwer Academic Publishers 2000).

demand levels in New York and Texas are taken into account, approval for BOC Company entry into long distance under Section 271 of the 1996 Act (*D271*) is not an important determinant of the demand for loop-switching combinations. With respect to the demand for loops purchased without switching, Section 271 approval negatively affects demand, and this result is statistically significant (t statistic = -1.99).[17] High non-recurring charges reduce demand for both types of loops (*DNRC*), and both estimated coefficients are statistically significance at better than the 10% level. Population density (*METPOP*) increases the demand for loops purchased without switching, but has no statistically significant effect on the demand for loop-switching combinations.

C. *A Test for Impairment*

When determining which network elements are to be made available as unbundled elements to CLECs, the Telecommunications Act requires the FCC to consider, "at a minimum, whether ... the failure to provide access to such network elements would impair the ability of the telecommunications carrier seeking access to provide the services that it seeks to offer."[18] The impairment standard is CLEC-specific ("*the* telecommunications carrier seeking access" and "services that *it* seeks to offer"), and a reasonable interpretation of the standard is whether the quantity of services supplied by the CLEC without access to the unbundled element is less than the quantity of services sold with the unbundled element.[19]

If a network element were easily replicable, then lack of access to the element would have no impact on the quantity of services sold. In the same way, any increase in the price of the element would have no effect on observed output of the CLEC (or CLECs as an aggregate), since a seamless migration to self-supplied elements would occur. Therefore, our empirical model allows a straightforward test of impairment.

The impairment standard is assessed by testing whether or not an increase in the price of switching has a (material) impact on the ability of a CLEC to the provide service it seeks to offer (local exchange service using unbundled loops). Because our data are aggregate CLEC activity, our test of impairment is limited

[17] Both Verizon in New York and SBC in Texas have 271 authority.

[18] 47 U.S.C. § 251(d)(2)(B).

[19] For a discussion of the impairment standard, see *Some Thoughts on Impairment*, Z-Tel Policy Paper No. 5 (available at www.telepolicy.com).

to an evaluation of all CLEC purchases of unbundled loops, rather than the more appropriate analysis of a single CLEC.

Two conditions serve as a test of impairment. First, as the price of unbundled switching rises, the quantity of loop-switching combinations declines. If switching is easily replicable, then the quantity of loops purchased without switching should increase in proportion to the loss of loop-switching combinations. A test of this condition is whether $\alpha_2 Q_L = -\beta_2 Q_S$ (where the quantities are measured at their mean values). Alternatively, the same information is gleaned from the condition $\partial Q_T/\partial P_S = 0$. As described above, neither condition holds; an increase in the price of unbundled switching reduces the quantity of loop-switching combinations (with elasticity -1.1) and has no effect on the quantity of loops purchased without unbundled switching, so that $\alpha_2 Q_L < -\beta_2 Q_S$.[30] Further, the price elasticity of all loops (Q_T) with respect to the switching price is –0.52 ($\partial Q_T/\partial P_S > 0$), and this elasticity is statistically different from zero. Thus, our results suggest that at least some CLECs are impaired in their ability to provide service without access to unbundled switching.

IV. Conclusion

Our econometric model indicates that demand curves for loops, whether purchased with or without unbundled switching, are downward-sloping and presently in the elastic region of demand. Likewise, the demand for unbundled switching is in the elastic region of demand. Most significantly, our empirical model provides no support for a substitution between unbundled and self-supplied switching at current element prices; the estimated cross-price elasticity with respect to loops purchased without switching and the price of unbundled switching is not statistically different from zero.

In addition, our empirical results are used to construct and perform a simple test of the impairment standard of the 1996 Telecommunications Act. The impairment standard requires the FCC to consider (at a minimum) whether a lack of access to an unbundled element will reduce meaningfully the ability of a CLEC to provide the services it seeks to offer. This standard suggests a rather straightforward empirical test, and our econometric estimates indicate that impairment exists with respect to unbundled switching. This test, however, is imperfect, given the aggregate nature of the data. Impairment, as defined by the 1996 Act, must be evaluated on a CLEC-by-CLEC basis.

[30] The null-hypothesis of equality of the two terms is rejected easily ($\chi^2 = 10.6$, Wald Test).

Empirical analysis is always subject to the quality of the data used and validity of the model's specification. The former we can do little about, and the latter we have addressed with careful model selection and a standard statistical test for specification error. As with all empirical analysis, however, this paper should be considered as but an element in a portfolio of evidence. Further research is always desirable.

Table 1. Variable Definitions, Sources, and Descriptive Statistics

Name	Description	Mean	St. Dev.	Source
Q_L	Quantity of unbundled loops sold on a standalone basis	34,469	103,695	(1)
Q_S	Quantity of unbundled loops sold with unbundled switching	198,580	359,745	(1)
Q_T	Total unbundled loops sold: $Q_L + Q_S$.	233,049	419,107	(1)
Q_L/Q_T	Share of standalone unbundled loops to total loops.	0.502	...	...
Q_S/Q_T	Share of unbundled loops with switching to total loops.	0.498	...	...
P_L	Index of average price of an unbundled loop (mean-centered index).	1.00	0.30	(2)
P_S	Index of average price for unbundled switching (i.e., non-loop costs, indexed by average loop price).	0.915	0.45	(2)
SIZE	Size of the market measured as average monthly retail rate for local services multiplied by total access lines.	113M	107M	(1, 4)
RESRAT	Ratio of business to residential retail rates: *PRES/PBUS*	0.560	0.193	...
PRES	Average residential rate in the state.	21.10	3.44	(4)
PBUS	Average business rate in the state.	41.34	13.34	(4)
RESSHR	Percent of analog, switched lines that are residential (*RESLINE*/(*RESLINE* + *BUSLINE*)).	0.752	...	(3)
RESLINE	Residential, analog, switched access lines.	2.35M	2.27M	(3)
BUSLINE	Business, analog, switched access lines.	0.94M	1.23M	(3)
DNYTX	Dummy variable that equals 1 if state is New York or Texas, 0 otherwise.	0.060	...	...
D271	Dummy variable for states granted 271 approval by the FCC: New York, Texas, Oklahoma, Kansas, Arkansas, Missouri, Massachusetts, and Pennsylvania.	0.179	...	...
DNRC	Dummy variable that equals 1 for states with loop-switching non-recurring charges exceeding $50.	0.045	...	(2)
METPOP	Percent of state population living in metropolitan areas.	0.715	...	(5)
DSAMPLE	Dummy variable that equals 1 for data as of Dec. 2001, 0 for data as of June 2001.	0.537	...	...

(1) FCC Data acquired by Freedom of Information Act request made by the PACE coalition.
(2) Provided by Z-Tel Communications.
(3) ARMIS Form 43-08, 2001 data.
(4) Gregg (2001).
(5) www.census.gov.

Table 2. Least Squares Estimates and Summary Statistics

	$\ln Q_L$	$\ln Q_S$
Constant	1.317 (0.27)	5.893 (1.88)[b]
$\ln P_L$	-1.725 (-5.39)[a]	1.654 (-2.82)[a]
$\ln P_S$	0.098 (0.58)	-1.122 (-3.59)[a]
ln*SIZE*	0.563 (6.05)[a]	0.388 (2.28)[a]
ln*RESRAT*	-0.133 (-0.51)	0.665 (1.39)
RESSHR	0.796 (0.43)	1.21 (0.35)
DNYTX	0.553 (1.65)[b]	2.589 (4.21)[a]
D271	-0.411 (-1.99)[a]	0.324 (0.85)
DNRC	-0.827 (-2.19)[a]	-1.247 (-1.80)[b]
METPOP	2.991 (5.64)[a]	-1.057 (-1.09)
DSAMPLE	0.275 (2.16)[a]	0.154 (0.66)
R^2	0.85	0.67
RESET F	0.89	0.84

[a] Statistically significant at the 5% level.
[b] Statistically significant at the 10% level.

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Phoenix Center Policy Paper Number 15:

A Fox in the Hen House: An Evaluation of Bell Company Proposals to Eliminate their Monopoly Position in Local Telecommunications Markets

George S. Ford, PhD

(September 2002)

Phoenix Center Policy Paper No. 15

A Fox in the Hen House: An Evaluation of Bell Company Proposals to Eliminate their Monopoly Position in Local Telecommunications Markets

George S. Ford, PhD*

Abstract: In this brief Policy Paper, the incentives of the Bell Companies to promote "real competition" by eliminating the Unbundled Network Element-Platform as an entry mode are examined. As common sense dictates, the Bell Company anti-Unbundled Network Element Platform message is not driven by a desire for "real competition," but an effort to shift competitive entry toward slower, less ubiquitous entry modes such as UNE-Loop and facilities-based entry. The increase and protection of profits is the goal of the Bell Company, not the altruistic promotion of consumer benefits created by the rapid introduction of competition into the local exchange market. Policymakers, at least wise policymakers, should not ignore this fact.

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I. Introduction

It is wise to be skeptical of those who seek to assist in their own demise. Despite the pedestrian nature of the observation, this bit of wisdom is frequently lost on telecommunications policymakers. In their efforts to promote competition and eliminate monopoly in the local exchange telecommunications marketplace, regulators and other policymakers frequently seek and, even worse, adhere to the advice of the incumbent monopolists – the Bell Companies.[1] Having incumbent monopolists as advisors for competition policy is like having the hen house guarded by a fox.

One policy proposal of the Bell Companies is that to promote "real" competition, regulatory agencies should eliminate the availability of loop-switching combinations (UNE-Platform) and entrants should be required to replicate substantial portions of the incumbent's network – primarily digital switching equipment – to provide service. If entrant-deployed digital switching helps promote "real competition," then why would a monopolist encourage regulators to mandate this entry strategy (or, eliminate other possible entry strategies that do not require switch redundancy)? If switch deployment by entrants does, in fact, promote "real competition," then presumably such entry would reduce the profits of the incumbent monopolists and *leave potentially billions of dollars of their own local exchange network stranded*. Are then the Bell Companies acting contrary to the interests of their shareholders? Or, is the "real competition" promoted by the Bell Companies a sham? The answer, quite fortunately, is found in a straightforward algebraic analysis.

In this brief paper, we examine the incentives of the Bell Companies to promote "real competition" by eliminating the UNE-Platform as an entry mode. As common sense dictates, the Bell Company efforts to eliminate UNE-Platform are shown to be an effort to raise Bell Company profits by shifting entry to slower, less ubiquitous entry modes such as UNE-Loop (unbundled loop with self-supplied switching).[2] Thus, eliminating UNE-Platform will result in *less* competition (and ultimately less of the redundancy that the Bell Companies claim to advocate, given that switch deployment is a complement to UNE-

[1] The Bell Companies are, for all practical purposes, monopolists in the local exchange market with demand penetration rates of over 90%.

[2] By no means is this observation meant to imply that UNE-Loop entrants should be impeded in any way by regulatory policy. All modes of entry should be encouraged by federal and state policy.

Platform).[3] This finding is unsurprising, given that securities law makes it difficult for the Bells to promote policies that will indeed promote "real competition" and thereby reduce its profits. Increasing and protecting profits is the goal of the Bell Companies, not the altruistic promotion of consumer benefits realized from the rapid introduction of competition into the local exchange market. Policymakers should not ignore this fact.

II. A Simple Economic Analysis

In order to find an answer to the question of whether the Bell Companies are legitimately trying to promote "real competition," thereby acting in conflict with the interest of their shareholders, or whether "real competition" is their hen house, a very simple economic analysis is used. As always, a few simplifications will make the analysis more tractable and accessible. While the following analysis is mathematical, it is relatively easy to follow. For those who prefer, numerical examples are provided in Section III that illustrate plainly the symbolic computations of this section.

To begin, first assume that a Bell Company has one retail service it sells at a regulated price P. This service is comprised of two inputs, namely input L and input S (e.g., loop and switching/transport).[4] The production of these inputs requires fixed (and probably sunk) cost F, and additional units of the input are supplied at marginal costs C_L and C_S, respectively. The per-unit price-marginal cost margin, therefore, is $(P - C_L - C_S)$, which is positive. Observe that this margin is computed as price over marginal cost, not average cost (either embedded or forward-looking). Marginal cost for embedded loop and switching plant should be very low, and well below average cost. Profit maximizing decisions are based on marginal cost, not average cost; so, our focus is on marginal cost.

In addition to its retail offering, the Bell Company also sells to other telecommunications carriers the inputs L and S at wholesale prices R_L and R_S, where the sum of the wholesale prices is less than the retail price $(P > R_L + R_S)$. The wholesale prices (R_L, R_S) are set equal to average cost (i.e., TELRIC), and therefore exceed marginal cost $(R_L > C_L, R_S > C_S)$.

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[3] See T. Randolph Beard, George S. Ford, and Thomas W. Koutsky, *Facilities-Based Entry in Local Telecommunications: An Empirical Investigation*, Unpublished Manuscript (www.telepolicy.com), June 2002.

[4] The production technology is fixed proportions; each unit of output requires one L and one S.

The (annual) profit function of the Bell Company is

$$\pi = (P - C_L - C_S)n_B + (R_L + R_S - C_L - C_S)n_P + (R_L - C_L)n_U - kF \qquad (1)$$

where k is factor that converts the fixed cost into depreciation and an annual "payment" to the capital (i.e. because profits are measured in annual terms), and n_i is the number of units sold by the Bell Company to either its own retail customer (subscript B), a wholesale-customer buying both L and S (subscript P, for "UNE-Platform"), or a wholesale customer buying just L (subscript U, for "UNE-Loop"). It should not be a surprise to anyone that the Bell Companies do not wish to wholesale inputs to their competitors; they have made their preference clear.

The question of interest is what "type" of entrant the Bell Company seeks to promote, and whether or not its decision is compatible with profit maximization and, thus, shareholder interests. In order to evaluate this issue, the total differential of Equation (1) is required:

$$\Delta\pi = (P - C_L - C_S)\Delta n_B + (R_L + R_S - C_L - C_S)\Delta n_P + (R_L - C_L)\Delta n_U\,, \qquad (2)$$

where the Δ symbol indicates "the change in." Equation (2) can be used to compute the change in profit for changes in the number of customers of each type, including the movement of a customer from, say, a retail product to a wholesale product. To illustrate, a one-unit increase in n_B increases profit by $[\Delta\pi/\Delta n_B = (P - C_L - C_S)]$.

The Bell Companies' distaste for the Telecommunications Act's unbundling mandates (i.e., forcing the Bells to offer wholesale products L and S) is revealed by Equation (2). If the Bell Company loses a retail customer $(\Delta n_B = -1)$ to a UNE-P provider $(\Delta n_P = +1)$, its profits change by

$$\Delta\pi/\Delta n_P - \Delta\pi/\Delta n_B = (R_L + R_S - C_L - C_S) - (P - C_L - C_S) = R_L + R_S - P\,, \qquad (3)$$

which is clearly negative because the retail price exceeds the sum of the wholesale prices $(P > R_L + R_S)$.[5] Equation (3) shows that the Bell Company

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[5] The regulated price is assumed to include all revenue from the customer, including universal service receipts.

continues to incur the marginal cost of both L and S, but loses retail revenue P that is replaced by wholesale revenue R_L and R_S.

Similarly, if the Bell Company loses a retail customer ($\Delta n_B = -1$) to a UNE-L competitor ($\Delta n_L = +1$), then its profits decline by

$$(R_L - C_L) - (P - C_L - C_S) = R_L - P + C_S, \tag{4}$$

which again is plainly negative because the retail price exceeds the wholesale price of both L and S and the wholesale prices exceed marginal cost ($R_L + C_S < P$).

Finally, if the Bell Company loses a retail customer to a full facilities-based competitor, the change in Bell profits is

$$-(P - C_L - C_S), \tag{5}$$

which is the largest loss of profit of any of the alternatives.

A more interesting scenario for the issue at hand is what happens to profits when a UNE-Platform customer ($\Delta n_P = -1$) migrates to UNE-Loop ($n_U = +1$). In this scenario, Bell Company profits change by

$$(R_L - C_L) - (R_L + R_S - C_L - C_S) = -R_S + C_S, \tag{6}$$

which again is negative because wholesale prices exceed marginal cost ($R_S > C_S$). Thus, promoting switch-based entry and the elimination of UNE-Platform entry *reduces* Bell Company profits. Bell Company advocacy of switch-based entry, consequently, is contrary to the interest of Bell Company shareholders! Or is it?

This simple analysis of one-customer migrations from UNE-Platform to UNE-Loop is a bit misleading, or even counterfactual. History shows that in New York State, about six times as many UNE-Platform lines as UNE-L lines are installed each month (about 30,000 to 5,000 per month), on average. This evidence suggests that for every one-customer migrating from the retail arm of the Bell Company to a competitor, there is a 15% chance that customer migrates to UNE-Loop and an 85% chance that customer migrates to UNE-Platform. For every successful acquisition by a competitor, therefore, the expected reduction in profits is

$$\begin{aligned}\Delta\pi &= 0.15(R_L - C_L) + 0.85(R_L + R_S - C_L - C_S) - (P - C_L - C_S) \\ &= R_L + 0.85R_S + 0.15C_S - P,\end{aligned} \tag{7}$$

which again is negative ($P > R_L + R_S$ and $R_S > C_S$). As a general matter, the migration of a retail customer to a wholesale customer reduces profits. Now, if the UNE-Platform is eliminated as an entry option, the expected reduction in profits is

$$\begin{aligned}\Delta\pi &= 0.15(R_L - C_L) - (P - C_L - C_S) + 0.85(P - C_L - C_S) \\ &= 0.15R_L + 0.15C_S - 0.15P,\end{aligned} \tag{8}$$

which is negative ($P > R_L + R_S$ and $R_S > C_S$). Note that we treat the expected migration to the UNE-Platform (0.85 customers) as a migration to the Bell Company (i.e., the customer is retained).

What remains to be determined is whether the expected change in profits after eliminating UNE-Platform as an entry option is less than the expected change in profits with UNE-Platform. Subtracting Equation (7) from Equation (8), we have

$$(0.15R_L + 0.15C_S - 0.15P) - (R_L + 0.85R_S + 0.15C_S - P) = 0.85(P - R_L - R_S), \tag{9}$$

which is clearly positive ($P > R_L + R_S$). Because the growth rate of UNE-Loop is considerably less than that of the UNE-Platform, eliminating UNE-Platform increases profits, despite the fact that a UNE-P wholesale account has a higher margin than a UNE-L wholesale account. In essence, the Bell Company loses more per lost customer, but they make it up in reduced volume.

If UNE-Platform and UNE-Loop are substitutes, an issue addressed and rejected by Beard and Ford (2002), then eliminating UNE-P may simply increase the number of UNE-Loop customers.[4] Assuming perfect substitution between UNE-Loop and UNE-Platform, and ignoring the capacity constraint on UNE-Loop caused by the hot-cut bottleneck, the promotion of UNE-Loop competition by eliminating the UNE-Platform is plainly unprofitable for the Bell Company and contrary to the interest of Bell Company shareholders. If the Bell Companies are profit-maximizing firms, therefore, then the inevitable conclusion

[4] T. Randolph Beard and George S. Ford, *Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network*, Unpublished Manuscript (July 2002), www.telepolicy.com.

is that the Bells do not believe that UNE Platform and UNE Loop are highly substitutable.

III. Numerical Examples

The symbolic analysis of the previous section can be presented as a numerical example, without loss of force. In order to do so, assume the following: the retail price for the Bell Company's service is $40 ($P = 40$); the wholesale price for input L (i.e., the loop) is $16 ($R_L = 16$), the wholesale price for input S (*i.e.*, switching) is $10 ($R_S = 10$), and the marginal cost for input L and S are $2 and $1, respectively ($C_L = 2$, $C_S = 1$). Specifying a value for fixed cost (F) is not required, since it does not affect the analysis of profit changes. The change in Bell Company profit from various migration scenarios is summarized in Table 1.

Table 1.

Scenario	Change in Bell Company Profit	Equation from Text
Retail to UNE-Platform	(16+10-2-1) – (40 – 2 – 1) = -14	Equation (3)
Retail to UNE-Loop	(16-2)+(40-2-1) = -23	Equation (4)
Retail to Facilities Based	(40 – 2 – 1) = -37	Equation (5)
UNE-Platform to UNE-Loop	(16-2) - (16+10-2-1) = -9	Equation (6)
Avg Retail to Wholesale	0.15*(16-2)+0.85*(16+10-2-1) - (40-2-1) = -15.35	Equation (7)
Avg Retail to Wholesale w/o UNE-Platform	0.15*(16-2)+0.85*(40-2-1) - (40-2-1) = -3.45	Equation (8)
Per-customer Profit Change from Eliminating UNE-Platform	$0.85(P - R_L - R_S) = 11.90$	Equation (9)

From Table 1, it is plain to see that losing a customer to a UNE-Loop provider (-$23) has a larger effect on profits than losing a customer to the UNE-Platform provider (-$14). *Most harmful to Bell Company profits is a loss to facilities-based provider* (-$37). Migration from a UNE-Platform competitor to a UNE-Loop competitor reduces profits by $9 per month.

The expected loss in margin from a lost retail customer is $15.35, but that expected loss is reduced to $3.45 per lost customer by eliminating UNE-Platform as a viable entry strategy. Thus, eliminating the UNE-Platform increases Bell Company profits.

IV. Conclusion

In this brief Policy Paper, the incentives of the Bell Companies to promote "real competition" by eliminating the UNE-Platform as an entry mode were examined. As common sense dictates, the Bell Company anti-UNE Platform message is not driven by a desire for "real competition," but an effort to shift competitive entry toward slower, less ubiquitous entry modes such as UNE-Loop. The analysis also shows reveals that of all the entry modes, pure facilities-based entry generates the largest reduction in Bell Company profits. Consequently, Bell Company pleas for policies aimed at promoting facilities-based entry should be viewed with great skepticism.

As should be expected, the increase and protection of profits is the goal of the Bell Company in its policy recommendations, not the altruistic promotion of consumer benefits created by the rapid introduction of competition into the local exchange market. Policymakers, at least wise policymakers, should not ignore this fact.

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Phoenix Center Policy Paper Number 16:

What Determines Wholesale Prices for Network Elements in Telephony? An Econometric Evaluation

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(September 2002)

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What Determines Wholesale Prices for Network Elements in Telephony? An Econometric Evaluation

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Abstract: The Bell Operating Companies ("BOCs") argue that Total Element Long Run Incremental Cost (TELRIC) prices set by State public service commissions have no nexus to the BOCs' actual forward-looking costs but are, instead, based on retail prices with the goal of ensuring that competitors have an adequate (if not outright excessive) margin, thus resulting in "parasitic" competition. This Policy Paper, however, empirically demonstrates that the data do not support the Bells' contentions, finding that the wholesale price for combination of unbundled elements is motivated primarily by forward-looking costs and secondarily by BOC retail profit margins. Simply stated, *wholesale prices for UNE-P are not directly related to retail prices for local telephone service.* In fact, rather than set rates below costs, the States more often than not have actually preserved some BOC profit in a politically-sensible "50/50" split between the desired outcomes of new entrants and the incumbents. The fact that BOC margins are declining is an intended consequence of Section 251(d) the 1996 Act and a rational public policy, because TELRIC pricing deliberately does not incorporate the monopoly rents the BOCs have traditionally enjoyed in the wholesale prices for UNEs.

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Equally as important, a careful analysis of the BOCs' own publicly stated retail and wholesale revenues and operational costs for local phone service refutes the BOCs' claims that wholesale revenues are insufficient to cover wholesale operational costs. Quite to the contrary, the data indicate that even though EBITDA margins for wholesale lines are approximately half that of retail lines, *the BOCs' wholesale margins are nonetheless positive, with EBITDA margins in percentage terms (revenues minus cost divided by revenues) for retail and wholesale services averaging 55% and 40%, respectively, and the wholesale EBITDA margin averaging about 40% of the retail EBITDA margin.*

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I. Introduction

The Bell Operating Companies ("BOCs") have recently launched a new campaign against the wholesale prices for unbundled elements ("UNEs") set under the Federal Communications Commission's cost standard – Total Element Long Run Incremental Cost or TELRIC. According to the Bells, TELRIC prices set by State commissions have no nexus to the BOCs' actual forward-looking costs but are instead based on retail prices with the goal of ensuring that competitors have an adequate (if not outright excessive) margin. The BOCs therefore contend that current wholesale prices for UNEs produce "parasitic competition,[1] reduce BOC revenues below operational costs,[2] and threaten the investment in the local exchange network.[3] This Policy Paper, however empirically demonstrates that the data simply do not support the Bells' contentions.

Econometric analysis presented in this Policy Paper indicates that, on average, the wholesale price for combination of unbundled elements called UNE-P (loop, switching, and transport) is motivated primarily by forward-looking costs (TELRIC) and secondarily by BOC retail profit margins.[4] As such, contrary to the BOCs' contentions, wholesale prices for UNE-P are not directly related to retail prices for local telephone service.

In fact, contrary to the BOCs' claims and criticisms of State ratemaking proceedings[5] (proceeding which, incidentally, are open for public participation and were recently described by the United States Supreme Court as "smoothly running" affairs[6]), it appears that the States not only have been extremely careful

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[1] *See, e.g.*, September 13, 2002 Comments of USTA President Walter M McCormick: The FCC's UNE-P and TELRIC policies have created "parasites that are content to feed off and weaken the host." Glenn Bischoff, *USTA Calls For the End of UNE-P, TELRIC*, TELEPHONYONLINE.COM (Sept. 13 2002).

[2] *See, e.g.*, SBC Press Release (September 17, 2002) where, according to SBC President Richard Daley, TELRIC pricing is "below cost" and is an "irrational and unsustainable subsidy that is threatening the future of our telecommunications infrastructure."

[3] *Id.*

[4] Because other factors influence the determination of wholesale prices, it is not correct to interpret these findings to mean that the wholesale price for the UNE-P is half-way between forward-looking cost and average retail revenues. Econometric analysis is a *ceteris paribus* (other things constant) analysis, estimating the unique contribution of each regressor to variation in the dependent variable.

[5] *See, e.g.*, *Washington Telecom Newswire* (September 9, 2002) (According to Verizon CEO Ivan Seidenberg: "State commissions don't get it. They don't have a clue because they are trapped" in an old view of regulatory policy.") Such criticisms are particularly puzzling given that the Bells' publicly reported to the FCC that States imposed TELRIC pricing as a pre-condition of receiving authority under Section 271 of the Telecommunications Act to provide in-region inter-LATA service.

[6] *See infra* nn. 25 and 27.

to ensure that TELRIC rates accurately reflect the BOCs' forward looking costs but moreover – particularly as telecoms is such a political business – States have actually preserved some BOC profit in a politically-sensible 50/50 split between the desired outcomes of new entrants and the incumbents. While retail margins matter, forward-looking costs explain three times as much of the variation in wholesale prices across states as does the retail margin, and six times as much as retail prices. The fact that BOC margins are declining is an intended consequence of Section 251(d) the 1996 Act and a rational public policy, because TELRIC pricing deliberately does not incorporate the monopoly rents the BOCs have traditionally enjoyed in the wholesale prices for UNEs.

Equally as important, a financial analysis of the BOCs' own publicly stated retail and wholesale revenues and operational costs for local phone service, along with a critical analysis of the investment reports frequently cited by the BOCs regarding the purported ill's of UNE-P, refutes the BOCs' claim that wholesale revenues are insufficient to cover wholesale operational costs. Quite to the contrary, the data indicate that even though EBITDA margins for wholesale lines are approximately half that of retail lines, *the BOCs' wholesale margins are nonetheless positive*. In fact, *the Bells'* EBITDA *margins in percentage terms (revenues minus cost divided by revenues) for retail and wholesale services average 55% and 40%, respectively, and the wholesale EBITDA margin averages about 40% of the retail EBITDA margin.*[7]

II Background

Prior to the 1996 Telecommunications Act, the local exchange telecommunications market consisted of integrated wholesale and retail market segments, with the entire market dominated by the incumbent local exchange carriers ("ILECS").[8] Competition was all but absent in both segments. In an

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[7] EBITDA margins are not profit margins per se. The EBITDA margin must be sufficient to cover economic depreciation and amortization (*i.e.*, EBIT or free cash flow) for the firm to "profitable" in any traditional sense of the term. The focus on EBITDA margins in this paper mirrors the BOCs recent policy statements. Further, economic depreciation is difficult to measure. *Cf.*, September 23, 2002 Ex Parte Communications from Z-Tel Communications in FCC CC Docket No. 01-338 examining the Impact of the UNE Platform on Bell Company financial results, showing that BOC EBITA margins are higher than those calculated herein.

[8] While there are literally thousands of ILECs in the United States, most are exempt from the unbundling obligations of the Act. In fact, the unbundling obligations so far have been relevant only for the Regional Bell Operating Companies ("BOCs") including BellSouth, Qwest (formerly US West), SBC, and Verizon.

effort to promote competition in local telecommunications markets, the 1996 Act split the integrated market into its wholesale and retail components by requiring incumbent local phone companies to provide elements of its network to rival telecommunications carriers at regulated wholesale prices.

Unbundling was never supposed to be an end in and of itself, however; rather – similar to the successful *Competitive Carrier* paradigm that brought competition in the long distance industry before it – Congress recognized that a mandatory wholesale market for local access is the most effective mechanism to "grow the market" and stimulate sufficient new non-incumbent demand for the wholesale local exchange network to warrant the construction of new local access networks by firms other than the ILECs.[10] Because entrants could be expected to build some network components more easily than others, and the cost-benefit calculus varies substantially among CLECs with different business strategies, it was vital that the ILECs' networks be made available on both a piece-part and combined basis.

Moreover, even though the Act requires that the ILECs provide these unbundled network elements ("UNEs") to retail telecommunications firms until the removal of the unbundling obligations has no material impact on retail competition,[11] policymakers must understand that given the complex supply-side

[9] *See* S. 652, H. Rpt. 104-458, 104th Cong., 2d Sess. (1996); *see also* David L. Kaserman and John W. Mayo, GOVERNMENT AND BUSINESS: THE ECONOMICS OF ANTITRUST AND REGULATIONS (1995) at pp 310-312 for a review of the effects of vertical integration on competitive entry.

[10] Given the above, it is extremely unclear why FCC Chairman Michael Powell would recently describe the unbundling provisions of the 1996 Act simply as a requirement that Bells "undergo[] a new layer of regulation" as a *quid pro quo* for the "rapidly dwindling" carrot of entry into the long-distance market. TELECOM A.M., *Telecom Industry Woes Not Consequence of Telecom Act, Powell Says* (19 September 2002), when the need to stimulate new non-incumbent demand to warrant the construction of new "last mile" networks, from an economic perspective, is irrelevant to whatever political "deal" was made to get the 1996 enacted into law. Like it or not, if policy makers remove the ability to stimulate sufficient non-incumbent demand via UNE-P, then the only other policy option that will provide sufficient economic incentive to construct new network facilities – the goal that so many politicians claim to prefer – is to go back to state-protected monopolies with guaranteed rates of return. For a full explanation of the history and rationale behind the unbundling provisions of the 1996 Act, *see* Mark Naftel and Lawrence J. Spiwak, THE TELECOMS TRADE WAR: THE UNITED STATES, THE EUROPEAN UNION AND THE WTO (Hart 2001), Chapter 9 *passim*.

[11] Sections 251(d)(2)(A)-(B) require the ILEC to provide unbundled elements as long as "the failure to provide access to such network element would impair the ability to provide the services that [the requesting carrier] seeks to offer."

economics of the local exchange network – *i.e.*, because firms must commit huge sunk costs and need to achieve scale economies quickly, the local market will be highly concentrated[12] – there is a tremendous amount of work that must be accomplished before anyone can plausibly argue that there is a workably competitive market for wholesale local exchange network elements.[13] Accordingly, relaxing the unbundling obligations of the 1996 at this time is plainly premature.[14]

A. *Relevant Statutory Provisions of the 1996 Act and the Allocation of Responsibilities Between the States and the Federal Government*

Like most statutes of this nature, Congress split the responsibilities for administering the provisions of 1996 Act between the FCC and the States in respect for the Constitutional principle of Federalism.

On one hand, Section 252(d)(A)(i) of the 1996 Act requires that wholesale prices for the unbundled network elements be "based on the cost (determined without reference to a rate-of-return or other rate-based proceeding) of providing the ... network element." Congress left the details of the particular cost standard to the Federal Communications Commission ("FCC"), and the FCC established a forward-looking cost standard called Total Element Long-run Incremental Cost ("TELRIC"). The FCC concluded that a "cost-based pricing methodology based on forward-looking economic costs ... best furthers the goals of the 1996 Act. In dynamic competitive markets, firms take action based not on embedded costs, but on the relationship between market-determined prices and forward-looking

[12] *See* T. Randolph Beard, George S. Ford and Lawrence J. Spiwak, *Why ADCo? Why Now? An Economic Exploration into the Future of Industry Structure for the "Last Mile" in Local Telecommunications Markets*, PHOENIX CENTER POLICY PAPER SERIES NO. 12 (2001) (http://www.phoenix-center.org/pcpp/PCPP12.pdf); *reprinted in* 54 FED. COM. L. J. 421 (May 2002) (http://www.law.indiana.edu/fclj/pubs/v54/no3/spiwak.pdf.

[13] Moreover, despite BOC claims, the 1996 Act does not require CLECs to transition from UNEs to their own facilities. Indeed, the number of retail telecommunications firms should exceed the number of wholesale firms (probably by a substantial amount). *Id.*

[14] *See, e.g.*, PHOENIX CENTER POLICY PAPER NO. 14, *Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network*, (September 2002) (http://www.phoenix-center.org/pcpp/PCPP14%20Final.pdf); PHOENIX CENTER POLICY PAPER NO. 15, *A Fox in the Hen House: An Evaluation of Bell Company Proposals to Eliminate their Monopoly Position in Local Telecommunications Markets*, (September 2002) (http://www.phoenix-center.org/pcpp/PCPP15%20Final.pdf).

economic costs."[14] The FCC further concluded, "[C]ontrary to assertions by some [incumbents], regulation does not and should not guarantee full recovery of their embedded costs."[16]

On the other hand, it is also important to understand that while the FCC defined the relevant cost standard, it is the *State* regulatory commissions that implement the standard when setting wholesale prices for unbundled elements.[17] As recognized by the Supreme Court in *AT&T Corp. v. Iowa Utilities Board*,[18] the FCC cannot establish a cost standard so strict that the standard effectively sets the wholesale price.[19] Unquestionably, Section 252 of the 1996 Act gives the States the right to set wholesale prices. States therefore have substantial latitude in setting wholesale prices, and are constrained only by the necessarily general forward-looking cost framework established by the FCC (*i.e.*, TELRIC).

A similar statutory division of authority applies to what network elements are unbundled. The 1996 Act gives the FCC authority only to establish a *minimum* list of unbundled elements (an issue that continues to work its way around the courts[20]), and the States can freely expand the list as each State sees fit.[21] In fact, many States, including, for example, Illinois[22] and Texas[23], have mandated unbundling under State statutes.

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[15] *Implementation of the Local Competition Provisions in the Telecommunications Act of 1996*, First Report and Order, CC Docket No. 96-98, 11 FCC Rcd 15499, 15782-807, (1996) at ¶ 619).

[16] *Id.* at ¶ 706.

[17] 47 U.S.C. § 252(d)(1).

[18] *AT&T Corp. v. Iowa Utilities Board*, 525 U.S. 366, 119 S.Ct. 721, 142 L.Ed.2d 835 (1999).

[19] *See id.*, 525 U.S. at 423 ("The FCC's prescription, through rulemaking, of a requisite pricing methodology no more prevents the States from establishing rates than do the statutory "Pricing standards" set forth in §252(d). It is the States that will apply those standards and implement that methodology, determining the concrete result in particular circumstances. That is enough to constitute the establishment of rates."); *accord Sprint v. FCC*, 274 F.3d 549 (D.C. Cir. 2001).

[20] *See, e.g.*, *United States Telecom Association et al. v. FCC*, 290 F.3d 415 (D.C. Cir. 2002).

[21] Section 251(d)(3) of the 1996 Act provides the State commissions with the authority to establish unbundling obligations in above and beyond the FCC's national minimums, so long as those obligations are consistent with the purposes of the Act. This section of the Act was necessary because many States had already begun to promote competition by mandating unbundling by the time the 1996 Act was passed.

[22] Illinois Public Utilities Act §§ 5/13-505.6; 514; and 801.

B. *The Dispute at Bar*

As expected, the incumbents have fought "tooth and nail" for the last six years against the FCC's proposed TELRIC methodology, arguing instead that the FCC should have adopted either an embedded cost or efficient component pricing rule ("ECPR") schemes.[24] Last Spring, however, the United States Supreme Court in its landmark case *Verizon v. FCC*[25] conclusively ended this debate, upholding the FCC's TELRIC methodology in its entirety.[26] In so doing, the Majority in *Verizon* very conscientiously and very deliberately took great pains to address and dispel the arguments made against TELRIC by the BOCs since the 1996 Act was first enacted, particularly that TELRIC produced confiscatory rates and that entrants using unbundled elements were "parasitic" competitors.[27]

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[23] Texas Utilities Code §§ 60.021-022.

[24] *See, e.g.*, December 19, 2001 Comments of Verizon Communications Inc. Before the National Telecommunications and Information Administration, In the Matter of Request for Comments on Deployment of Broadband Networks and Advanced Telecommunications, Docket No. 011109273-1273-01 (available at http://www.ntia.doc.gov/ntiahome/broadband/comments/verizon/verizon.htm); December 19, 2001 Comments of Verizon Communications Inc. Before the National Telecommunications and Information Administration, In the Matter of Request for Comments on Deployment of Broadband Networks and Advanced Telecommunications, Docket No. 011109273-1273-01 (available at http://www.ntia.doc.gov/ntiahome/broadband/comments/SBCComments.htm); December 19, 2001 Comments of BellSouth Communications Inc. Before the National Telecommunications and Information Administration, In the Matter of Request for Comments on Deployment of Broadband Networks and Advanced Telecommunications, Docket No. 011109273-1273-01 (available at http://www.ntia.doc.gov/ntiahome/broadband/comments3/BellSouth.htm). According to the ECPR, "the access fee paid by the rival to the monopolist should be equal to the monopolist's opportunity costs of providing access, including any forgone revenues from a concomitant reduction in the monopolist's sales of the complementary component." Nicholas Economides and Lawrence J. White, *Access and Interconnection Pricing: How Efficient is the Efficient Component Pricing Rule?* 40 ANTITRUST BULLETIN (1995), p. 557-79.

[25] *Verizon Communications Inc. v. FCC*, 122 S. Ct. 1646 (2002).

[26] *Id.* at 1677 ("The incumbents have failed to show that TELRIC is unreasonable on its own terms … Nor have they shown it was unreasonable for the FCC to pick TELRIC over alternative methods …").

[27] For a full discussion of the *Verizon* Opinion and the current FCC broadband initiatives, *see* Lawrence J. Spiwak, *The Telecoms Twilight Zone: Navigating the Legal Morass Among the Supreme Court, the D.C. Circuit and the Federal Communications Commission*, PHOENIX CENTER POLICY PAPER SERIES No. 12 (August 2002) (http://www.phoenix-center.org/pcpp/PCPP13Final.pdf); COMMUNICATIONS WEEK INTERNATIONAL, *Opinion: U.S. Competition Policy – The Four Horsemen of the*

(Footnote Continued . . .)

Despite the Supreme Court's holding in *Verizon*, the BOCs continue to push policy-makers to abandon (or at minimum weaken) TELRIC pricing.[28] Having lost on the choice of overall ratemaking methodology, however, the BOCs are now criticizing how the rate methodology is applied. In particular, the BOCs contend that wholesale prices for UNEs have no nexus to their true forward-looking costs, but are instead set based upon retail prices so as to ensure that new entrants have an adequate (if not outright excessive) margin to arbitrage (*ergo* producing "parasitic" competition). For example:

- Verizon Communications CEO Ivan Seidenberg recently told the FCC Commissioners that "[S]tates have set discounts against below cost residential retail rates rather than on any realistic measure of cost."[29]

- SBC President William Daley recently opined that "[regulators] choose inputs that will achieve a predetermined end-result: a TELRIC rate that will give AT&T the 45% margin it demands before it will enter local markets [using the unbundled network element platform]."[30]

- In an recent investor interview with Bear Sterns, senior SBC management stated that: (a) in California, because "competition intensified in California after UNE rates were lowered in May", SBC expects to file a cost docket with the California PUC (CPUC) in hopes of *raising* UNE rates to what SBC believes is a cost-based rate; (b) in the old Ameritech region, high retail rates and far below cost UNE rates ($14-$15) were a key reason for continued line losses in the region, going so far as to note that

Broadband Apocalypse (01 April 2002) (available at http://www.phoenix-center.org/commentaries/CWIHorsemen.pdf).

[28] Letter to FCC Chairman Michael K. Powell from William H. Daley, President, SBC Communications, September 4, 2002.

[29] Ex Parte Presenation, Messrs. I. Seidenberg, W. Barr, and T. Tauke and Ms. D. Toben, representing Verizon, met separately with Chairman Powell and Mr. C. Libertelli, Commissioner Abernathy and Mr. M. Brill, Commissioner Copps and Mr. J. Goldstein, and Commissioner Martin and Mr. D. Gonzales (Ms. Toben did not attend this meeting), WC Docket No. 01-202 Verizon Petition for Emergency Declaratory and Other Relief; CC Docket No. 01-338 Review of the Section 251 Unbundling Obligations of Incumbent Local Exchange Carriers: CC Docket No. 96-98 Implementation of the Local Competition Provisions in the Telecommunications Act of 1996: and CC Docket No.98147 Deployment of Wireline Services Offering Advanced Telecommunications Capability, August 16, 2002, at 16. *See also* CCMs (2002) and UBSWarburg (2002).

[30] *Telecommunications Reports Daily*, September 12, 2002.

approximately 70% of SBC's UNE-P growth [illegible] the Ameritech region alone; but that (c) in the SBC States "competitive penetration of the region's local market has flattened in the 15%-20% range" because of "reasonably-priced UNE rates (in the $20 range)."[31]

Of course, the issue of whether wholesale UNE prices are based on something other than forward-looking costs is an empirical question, and "empirical questions cannot be answered by non-empirical arguments."[32] Fortunately, the question of how wholesale prices for UNEs are determined is ideally suited for multivariate econometric analysis, and that approach to answering this empirical question is taken up in the following sections. As demonstrated empirically in Section III, the BOCs' arguments highlighted above plainly fail on the merits.

C. *What Determines TELRIC Pricing?*

Conceptually, forward-looking costs should be the primary driver of wholesale prices. Other factors, however, can influence the price-determining decisions. Of the potential factors driving wholesale price determination, by far the most recognizable other than forward-looking costs include (a) embedded costs; (b) retail opportunity cost, *i.e.* the margins lost by the ILEC when a customer shifts from its retail service to a UNEP-based CLECs; and (c) retail prices. Pricing to protect existing margins is termed the efficient component pricing rule ("ECPR"), and ECPR is the most preferred pricing methodology of the BOCs.[33]

More importantly, even accepting the BOCs' position *arguendo* that retail prices play a meaningful role in the determination of wholesale prices, it is still not clear that a consideration of retail prices when setting wholesale prices is even problematic. That is to say, in order for a rate to be "just and reasonable," prices only need to fall within a "zone of reasonableness"– that is, that these rates must be neither "excessive" (rates that permit the firm to recover monopoly rents

[31] Bear, Stearns & Co. Inc. Equity Research, SBC *Communications Inc. – Outperform: Highlights From Meeting With SBC Management* (September 10, 2002).

[32] George Stigler, THE ORGANIZATION OF INDUSTRY (1968), at 115.

[33] *See* Economides and White, *supra* n. 24; *see also* Beard, Ford, and Spiwak *supra* n. 12.

or "creamy returns") nor "confiscatory" (rates that do not permit the regulated firm to recover its costs).[34]

Yet, while this standard is not very precise, the phrase "just and reasonable" is clearly more than a "mere vessel into which meaning must be poured."[35] Rather, the delineation of the "zone of reasonableness" in a particular case will involve a "complex inquiry into a myriad of factors."[36] These myriads of factors, however, may include both *cost and non-cost* factors to determine whether particular rates fall within the zone.[37] Accordingly, if the "zone of reasonableness" of TELRIC is bound by cost estimates C_{LO} and C_{HI}, then choosing a wholesale price close to C_{LO} generates more competition than a wholesale price near C_{HI} and any wholesale price between C_{LO} and C_{HI} is *a priori* just and reasonable.

The D.C. Circuit recently addressed this very issue in *Sprint v. FCC*.[38] In *Sprint*, the D.C. Circuit concluded in although in "an otherwise undistorted market, firms capable of efficiently supplying the non-BOC elements should be able to compete....",[39] the "issue is not guarantees of profitability, but whether

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[34] *Farmers Union Cent. Exch., Inc. v. FERC*, 734 F.2d 1486, 1502. (D.C. Cir. 1984). Courts generally give administrative agencies substantial discretion to define this zone. Indeed, as the D.C. Circuit Court once explained, when examining an agency's determination that a particular rate falls within the zone of reasonableness, it is not a court's "function . . . to impose [its] own standards of reasonableness upon the Commission, but rather to ensure that the Commission's order is supported by substantial record evidence and is neither arbitrary, capricious, nor an abuse of discretion."; *see also Ralph Nader v. FCC*, 520 F.2d 182, 192 (D.C. Cir. 1975)(citations omitted). However, the court was also quick to point out that, "[i]n terms of ratemaking, the agency's expertise allows us to accept its judgment after it defines the zone of reasonableness; *but we cannot rely on claims of judgment to explain how the agency arrived at the zone.*" *Id.* at 193 (emphasis added).

[35] *See Farmers Union*, 734 F.2d at 1504.

[36] *Id.* at 1502.

[37] *Id.* When considering the latter, courts have upheld the legitimate role non-cost factors may play in order to achieve a particular public policy objective (*e.g.*, a desire to establish additional supply), so long as the agency specifies the nature of the relevant non-cost factor and offers a reasoned explanation of how the factor justifies the resulting rates. *Id.* at 1502-03 (citations omitted); *see also National Ass'n of Regulatory Utility Comm'rs v. FCC*, 737 F.2d 1095, 1137 (D.C. Cir. 1984); *National Rural Telecom Ass'n v. FCC*, 988 F.2d 174, 182-83 (D.C. Cir. 1993) (affirming price cap regulation although not tied directly to cost).

[38] 274 F.3d 549 (D.C. Cir. 2001).

[39] *Id.* at 270.

the UNE pricing selected (i.e., TELRIC) [illegible] competition to fail."[40] Indeed, because the court found that (a) "the [1996] Act aims directly at stimulating competition",[41] and (b) TELRIC is not an "exact science" and produces a "wide zone of reasonableness,"[42] wholesale prices for UNEs can be related to both forward looking costs and retail prices so long as wholesale prices based on TELRIC at least produce sufficient margin for competition.

Accordingly, the relationships of wholesale prices to forward-looking cost, embedded cost, retail opportunity costs (*i.e.*, ECPR), and retail prices are key policy issues and the corresponding ability to understand the significance of the determinants of wholesale prices for UNEs is crucial going forward. The primary purpose of this Policy Paper, therefore, is to decipher empirically the relative contribution of these four factors – forward-looking cost, embedded cost, retail opportunity cost or ECPR, and retail prices – to wholesale prices for UNEs. The model conclusively demonstrates that variations in wholesale prices are unrelated to variations in retail prices – *i.e.*, that prices are in fact primarily set on the incumbents' forward-looking costs and not arbitrarily in order to preserve an arbitrage opportunity for entrants pursuing a UNE-P strategy.

III. The Model: Empirical Evidence of Wholesale Price Determination for UNEs

A. *Analytical Framework*

The wholesale price for UNEs (P), as determined by State regulatory commissions, can be viewed as a function of forward-looking costs (C) plus an additive term (Δ):

$$P = g(C) + \Delta(Z, \varepsilon) \tag{1}$$

where this additive term (either positive or negative) reflects the systematic (Z) and idiosyncratic influences (ε) on wholesale price determination. As previously mentioned, systematic influences may include the embedded/current costs and revenues, since the ILECs want wholesale prices sufficiently high to cover these costs or, alternately, to make them financially whole despite competition (*i.e.*, the

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[40] *Id.* at 271 (Emphasis in original).

[41] *Id.* at 555.

[42] *Id.* (citations omitted).

result of the ECPR). In contrast, because competitive entry is the stated goal of the 1996 Act, retail prices also may contribute to the determination of wholesale prices. If wholesale prices are not sufficiently low to induce entry, the entire process could be considered wasted effort.

Without question, the most hotly contested telecommunications policy issue today is the availability and/or price for the UNE-P. Thus, an econometric model based on Equation (1) is specified that allows for the estimation of the relative influence of a variety of factors on the wholesale price for the UNE-P. The UNE-P is a combination of an unbundled loop, switching functionality, and transport. The UNE-P allows competitive local exchange carriers ("CLECs") to provide local phone service using primarily the ILECs' network, thereby reducing the sizeable up-front and sunk investment typical of facilities-based entry into the local exchange market. UNE-P is the most successful and highest growth mode of competitive entry for residential consumers in the industry today and, as such, is the mode of entry most under attack by the BOCs.

Generally, a statistical test for the relative influence of cost (forward-looking and embedded) and retail prices on wholesale prices takes the general form:

$$P = \alpha_0 + \alpha_1 C + \alpha_2 T + \alpha_3 M + \alpha_4 E + \alpha_5 X + \varepsilon, \qquad (2)$$

where P is wholesale price, C is forward-looking cost, T is retail price for residential local telephone service, M is the retail opportunity cost (average revenue minus forward-looking cost), E is embedded cost, X is a portmanteau variable summarizing other variables that may affect P, ε is a well-behaved econometric disturbance term, and the α's are the estimated coefficients of the least squares regression.[43] The disturbance term ε captures the random, idiosyncratic differences among State commissions in setting wholesale prices that are not captured by the variables in the model.

The variables of primary interest in an econometric analysis of wholesale prices include C, T, M, and E. While both the size and statistical significance of the estimated coefficients for each of these variables is important, the primary

[43] Jack Johnston and John DiNardo, ECONOMETRIC METHODS (4th Ed. 1997), at 16-7. We also tested for a bias against low wholesale prices by estimating the coefficient α_1 for States with below average costs and another coefficient for those above. There was no statistical difference is the estimated coefficients.

method of evaluating their relative influence on wholesale prices [illegible] determine the contribution of each variable to explaining the variation in the wholesale price. This "contribution" is measured by the partial coefficient of determination, or partial R-squared for each of the variables of interest.[44] The larger the partial R-squared of the explanatory variable, the more that variable contributes to explaining the variation in the dependent variable P, other factors held constant. For example, if the partial R-squares of C and M are 0.30 and 0.15, then C explains twice as much of the variability in P as does M. Thus, the relative importance of each factor to wholesale price can be assessed directly, even if more than one factor is found to be a statistically significant determinant of wholesale price.

The magnitudes of the estimated coefficients (if statistically different from zero) are also of interest when testing some potential theoretical models of wholesale price determination. For example, State regulatory commissions are fond of rendering decisions that lie between the proposals of the adversaries. Computing a simple average of the two positions is not uncommon, though this "technique" is rarely cited explicitly. In the context of Equation (2), a "position averaging" approach to wholesale price determination suggests that the coefficient α_1 will equal 1.00 and α_3 will equal 0.50. In other words, the primary position of the CLECs (and the FCC) is that wholesale prices should equal forward-looking costs. The ECPR is the favored price methodology of the ILECs.[45] What the coefficient values just mentioned imply is that wholesale price is set equal to cost (α_1 = 1.00) plus one-half (α_3 = 0.50) of the retail opportunity cost (M), where the latter is a proxy for the ECPR. A statistical test of these coefficient restrictions will indicate whether existing wholesale prices for UNE-P have been determined using the "position averaging" approach.

The BOCs' contention that wholesale prices for UNEs are driven by retail prices is statistically evaluated by the coefficient on and partial R-squared of the retail price variable T. *A priori* expectations regarding the effect of T on P are necessarily ambiguous. While the BOCs argue lower retail prices will lead to

[44] The partial R-square is computed using $t^2/(t^2 - n - k)$, where t is the t-statistic from the regression on the relevant variable, n is sample size (45) and k is the number of regressors in the model (7). Adrian C. Darnell, A DICTIONARY OF ECONOMETRICS (Edward Elgar, 1994), p. 302-3. The partial r-squared measures the influence of the variable assuming that it is the last variable added to the model (i.e., the effect of the other explanatory variables on the dependent variable is already accounted for).

[45] *See* Beard, Ford and, Spiwak, *supra* n. 12.

lower wholesale prices (*i.e.* $\alpha_2 > 0$), an equally plausible expectation is that high retail prices encourage State commissions to set lower wholesale prices in the hope that competition will reduce retail margins (*i.e.*, $\alpha_2 < 0$). The econometric analysis will reveal which, if either, of these competing hypotheses better describes the data.

B. *Data*

All data is measured at the State level for Bell Company territories in the contiguous 48 States except for Connecticut, Rhode Island, and Nevada (leaving 45 observations). These States were excluded from the sample due to missing data on wholesale prices.[46] These excluded States account for fewer than one-percent of all access lines (0.8%). Descriptive statistics and sources are provided in Table 1.

Wholesale prices are measured using summary information provided by Commerce Capital Markets (2002, "CCM").[47] This source of data provides estimates of switching costs, but the estimates are in error for many States. Thus, wholesale prices for unbundled switching are computed by adjusting the CMM estimates to better match up with the actual wholesale prices for unbundled switching. These adjustments were provided to the authors by Z-Tel Communications, a competitive carrier currently serving over 40 States using UNE-P.[48] For comparison purposes, the regression also is estimated using the unadjusted CCM data and the results presented, but we do not discuss this alternate regression. The more interesting results for the two different dependent variables are virtually identical.

Forward-looking cost C is measured by the output of the publicly-available Hybrid Proxy Cost model ("HCPM"), a forward-looking cost model developed

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[46] Wholesale price data is restricted to Bell Company territories, so that Hawaii and Alaska are excluded. CCM rate data was not available for Connecticut, and switching price data was unavailable for Nevada and Rhode Island.

[47] Anna Maria Kovaks, Kristin L. Burns, and Gregory S. Vitale, *The Status of 271 and UNE-Platform in the Regional Bells' Territories*, Commerce Capital Markets Equity Research (August 22, 2002). For the dependent variable, we use "FULL UNEP ORIGINATING AND TERMINATING, Assumes DEM minutes, TOTALS" column, Exhibit 2.

[48] Computing the cost of the UNE-P is a difficult undertaking. The authors are indeed grateful to Z-Tel Communications, who has two full time employees devoted to the task of interpreting UNE tariffs, for sharing the data.

by the FCC.[49] This variable is a summary index for all the State specific exogenous (*i.e.*, geographic) effects that influence the forward-looking cost of network elements. For consistency with the ILEC position that "[S]tates have set discounts against below cost residential retail rates rather than on any realistic measure of cost," retail price T is measured by the residential retail rate. Gregg (2001) provides State-by-State measures of retail residential rates.[50] Retail opportunity costs M are computed as the difference between average revenue per line (A), computing using ARMIS data, and forward-looking cost C.[51] Embedded costs E are measured as total expenditures per access line (switched and special), and these costs are provided by ARMIS.[52]

Also included as regressors are ILEC specific dummy variables for BellSouth (DBLS), Verizon (DVZ), and Qwest (DQWST).[53] For the ILEC dummy variables, the variable equals 1.00 if the relevant carrier serves the State, zero otherwise. Given that the ILECs present very similar cases during the cost proceedings within their regions, the costs within each ILEC region may be more alike than costs between ILEC regions. These dummy variables should capture that effect, as well as any difference in the success of political influence exerted on State commissions by the ILECs (or any other ILEC specific influence on wholesale prices). The estimated coefficients on the dummy variables measure the difference between these three ILECs and SBC (the dummy for which is excluded so the model can be estimated).[54]

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[49] The model and its output can be downloaded at: http://www.fcc.gov/wcb/tapd/hcpm/. The method used to compute the cost per line (loop and switching) follows the FCC's methodology used in its latest 271 Orders. *See, e.g.*, *In the Matter of Application of Verizon Pennsylvania Inc., et al. for Authorization to Provide In-Region, InterLATA Services in Pennsylvania*, Memorandum Opinion and Order, FCC 01-269, ___ FCC Rcd ___ (rel. Sept. 19, 2001).

[50] Gregg, Billy Jack, (2001). *A Survey of Unbundled Network Element Prices in the United States* (unpublished manuscript, updated July 1, 2001); available at http://www.nrri.ohio-state.edu/programs/telecommunications.html.

[51] *See* Table 1 for a description of the calculation.

[52] *See* Table 1 for a description of the calculation.

[53] States are assigned to each ILEC as follows: BellSouth (AL, GA, FL, KY, LA, MS, NC, SC); Verizon (NY, MA, ME, WV, VT, PA, VA, MD, NJ, DE, RI, NH); and Qwest (AZ, CO, ID, IA, MN, MT, NE, NM, ND, OR, SD, UT, WA, WY).

[54] Johnston and DiNardo, *supra* n. 43 at 134-7.

C. *Model Specification*

Equation (2) is estimated in both level and double-log form and the alternate specifications are summarized as:

$$P = \alpha_0 + \alpha_1 C + \alpha_2 T + \alpha_3 M + \alpha_4 E + \alpha_5 BLS + \alpha_6 DVZ + \alpha_7 DQWST + \varepsilon_a \tag{3a}$$

$$\ln(P) = \beta_0 + \beta_1 \ln(C) + \beta_2 \ln(T) + \beta_3 \ln(M) + \beta_4 \ln(E) + \beta_5 DBLS + \beta_6 DVZ + \beta_7 DQWST + \varepsilon_b. \tag{3b}$$

In level form, the estimated coefficients (α's) measures unit changes in the dependent variable for unit changes in the explanatory variables. For example, a $1 change in C leads to a α_1 change in P. In log-log form, the estimated coefficients (β's) measure elasticities. For example, a ten percent change in C equals a β_1 percent change in P. The marginal effect of a dummy variable in the log regression is measured by $e^{\beta} - 1$. The Box-Cox test indicated that the log specification provides for a better fit.[55]

Four models are estimated. Models 1, 2, and 3 use the adjusted CCM data, whereas Model 4 uses the unadjusted CCM data. Model 3 is estimated using average revenue per line A rather than the retail margin M. Model 3 is estimated to evaluate the treatment of forward-looking cost in the computation of the retail margin. Implicitly, when computing M the assumption is that C is an accurate measure of the *absolute* level of forward-looking costs, rather than just a reliable index of the *relative* level of forward-looking costs across States. By using average revenue per line rather than the retail margin, the assumption that C measures the absolute level of forward-looking cost is avoided. This change in model specification will reduce the coefficient and t-statistic on C, but the other coefficients and t-statistics in the model are unaffected (since C was held constant in the model). Both Models 3 and 4 are provided for illustrative purposes only, and the results are not discussed in any detail. All regression results are summarized in Table 2.

Econometric specification errors such as omitted variables, endogenous explanatory variables, errors in measurement, and an incorrect functional form

[55] A. H. Studenmund, USING ECONOMETRICS (1992) at pp. 228 and 250.

can each cause least-squares estimates to be biased, inconsistent, and inefficient.[56] The RESET test is a rather general test of specification error, and is capable of detecting all of the specification problems listed above (Ramsey 1969), and the test is particularly sensitive to omitted variables and incorrect functional form.[57] The null hypothesis for RESET is "no specification error," so specification error is indicated if the null-hypothesis is rejected. The RESET F-statistics are provided in Table 2, and none of the statistics is near statistically significance for Models 1, 2, and 3, so there is no evidence of specification error (*i.e.*, null-hypothesis of "no specification error" cannot be rejected at standard significance levels). Accordingly, the RESET test indicates that the regression equations do not suffer from these important specification errors. The null hypothesis of no specification error is rejected for Model 4.

Another test for specification error is the White test, which is used as a test for heteroscedasticity.[58] Heteroscedasticity results in unbiased but inefficient coefficient estimates, implying the standard errors of the estimated coefficients are too large (and, consequently, the t-statistics are too small). We are unable to reject the null hypothesis of the White test (homoscedastic errors) at even the 10% level for Models 1 and 2.

Because the regression includes a number of measures of prices and costs, there exists the potential for multicollinearity to influence the efficiency of the standard errors (and thus the t-statistics). The correlation coefficients of the variables are provided in Table 1, and none of these coefficients exceeds 0.60. So, while there is some correlation between the regressors (as always), the correlation is not particularly high.[59] Nevertheless, Variance Inflation Factors ("VIFs") were computed for each explanatory variable (C, T, M, and E), and none of the VIFs exceeded 3.45 (with 5.00 being the rule-of-thumb standard for

[56] These errors violate the least squares assumption of a null mean for the theoretical disturbance vector. *See* Johnston and DiNardo, *supra* n. 43, Ch. 4.

[57] The RESET Test is valid only for least-squares regressions. Ramsey's RESET Test is performed by including as regressors the powers of the predicted values of the regression. The joint significance of these additional regressors is evaluated, and the null hypothesis of "no specification error" is rejected if the RESET F-Statistic exceeds the critical value (*i.e.*, the test of the joint restriction that all of the additional coefficients equal zero is statistically significant).

[58] Johnston and DiNardo, *supra* n. 43 at 166-7.

[59] Some researchers use 0.80 as a rule-of-thumb for meaningful multicollinearity. *See* Studenmund, *supra* n. 55 at p. 273.

meaningful multicollinearity).[60] Furthermore, multicollinearity typically leads to low t-statistics and a high R-squared. While the R-squares of the regressions are high, so are the t-statistics. Thus, the efficiency of the estimates does not appear to be affected adversely by correlation among the regressors.

IV. Summary of Findings

Results from the least squares estimation of Equations (3a) and (3b) are summarized in Table 2 as Models 1 and 2. Most of the explanatory variables are statistically significant at the 5% level, and both Models 1 and 2 explain about 75% of the variation in the wholesale price for UNE-P.[61] R-square is often low for cross sectional data, so the relatively high R-squares (0.73 to 0.77) for the regressions are encouraging.[62] The marginal impacts from both specifications are nearly identical, so the summary of the results is based on Model 1, which is easier to interpret.

Variables of primary interest include the cost variable (C), the retail price variable (T), the retail opportunity cost (M), and the embedded cost variable (E). In both regressions (Models 1 and 2), the forward-looking cost variable is a statistically significant determinant of the wholesale price (at better than the 5% level). Clearly, forward-looking cost is an important factor in setting wholesale prices for unbundled elements. Model 1 indicates that wholesale prices adjust on a dollar-for-dollar basis ($\alpha_1 = 1.03$) with forward-looking cost (*ceteris paribus*).[63] The partial R-squared for C in Model 1 is 0.33 and 0.35 in Model 2.

In neither of the two regressions is the coefficient on retail price (T) statistically different from zero (and its sign is negative). *Thus, retail price is found to have no statistically significant effect on wholesale prices for the UNE-P.* The partial R-squared for retail price is 0.05 and 0.07 in Models 1 and 2, indicating very little of the variation in wholesale prices is explained by retail prices. Likewise,

[60] *See id.*, p. 275.

[61] R-square is defined as the explained variability in the data divided by the total variability of data, measured as the sum of squared deviations. Thus, R-square indicates the percentage of variability of the dependent variable that is explained by the econometric equation. R-square has values equal to or between 0 and 1. An R-square of 1 indicates that the model explains all the variation in the dependent variable. Johnston and DiNardo, *supra* n. 43 at 21-2.

[62] Studenmund, *supra* n. 55 at 47.

[63] The null hypotheses that $\alpha_1 = 1.00$ and $\beta_1(P/C) = 1.00$ could not be rejected (where P and C are measured at their sample means).

embedded cost E is not statistically significant in either model. The variable's partial R-squared ranges from 0.01 to 0.05.

In both models, the retail opportunity cost M is statistically significant and the coefficient is positive. Thus, BOC attempts to incorporate retail margins into wholesale prices has met with some success. These efforts are unquestionably indirect, since the proposed wholesale prices of the BOCs are always characterized as "TELRIC compliant." Of course, there is nothing to hinder the BOCs from calling an ECPR price, or any price for that matter, TELRIC-compliant. The estimated coefficient α_3 in Model 1 indicates that wholesale prices increase by about $0.46 for every $1.00 increase in the retail opportunity cost of the ILEC. Partial R-squared for M ranges from 0.10 to 0.11. Interestingly, it is not possible to reject the hypothesis that $\alpha_3 = 0.50$.[64] Because we cannot reject the hypotheses that $\alpha_1 = 1.00$ and $\alpha_3 = 0.50$, the "position averaging" hypothesis cannot be rejected statistically; the empirical evidence supports the notion that wholesale prices for UNEs are determined (*ceteris paribus*) by averaging forward-looking cost and ECPR.[65]

Reviewing the partial R-squares of variables C, T, M, and E, the evidence consistently supports the notion that wholesale prices are strongly influenced by forward-looking costs. Forward-looking costs explain about six times as much of the variation in wholesale prices than do retail prices, about three-times as much as retail opportunity costs, and about twelve times as much as embedded cost. The second largest determinant of wholesale prices (of these four variables) is retail opportunity cost M, explaining nearly twice as much as retail price and nearly four times as much as embedded cost. Neither retail price T nor embedded costs E contributes significantly to explaining variations in wholesale prices. An F-test on the restriction that the coefficients on both T and E are zero cannot be rejected (F = 0.95).

There exist systematic and sizeable non-cost based differences in wholesale prices for UNEs across the BOCs; all the ILEC dummy variables are positive and statistically significant. Relative to SBC, all three Bell Companies appear to have attained successfully higher wholesale prices on average, for reasons other than those factors included in the regression. On average and holding forward-

[64] The null hypotheses that $\alpha_1 = 0.50$ and $\beta_3(P/M) = 0.50$ could not be rejected (where P and M are measured at the sample means).

[65] For Model 3, the "position averaging" hypothesis ($\alpha_1 = \alpha_3 = 0.50$) cannot be rejected.

looking costs (and other regressors) constant. BellSouth and Verizon's wholesale price for UNE-P are about $10 higher than SBC and $6 higher than Qwest.[66] Qwest's UNE-P price is $4 more than SBC's UNE-P price, on average and *ceteris paribus*. Thus, the econometric evidence provides perhaps an explanation as to why SBC is the most vocal opponent of UNE-P across the BOCs.

V. Relationship of UNE Prices to ILEC Costs

In addition to the contention that wholesale prices for UNEs are not based on forward-looking costs, the BOCs further claim that prices for the UNE-P are "below operational costs."[67] Combining the retail and wholesale revenues per line used for the regression analysis above with data on current operational costs per line, it is possible to assess the claim that UNE-P prices are "below operational costs."

Per-line operational costs for retail and wholesale customers is computed using Form 43-03 of the ARMIS data (Year 2001).[68] Line 720 reports total operational expenses at the State level, from which is subtracted depreciation and amortization expenses (Line 6560). The remainder is divided by total access lines (ARMIS Form 43-08, Year 2001) to produce retail operational cost per access line.[69] Wholesale operational costs per line are computed by subtracting from total operational costs (excluding depreciation) all marketing and customers services costs (Lines 6610, 6620) and Access Expenses (Line 6540).[70] Again, these expenses are divided by total access lines (switched plus special). The average retail expense per line is $18.20, whereas the average wholesale cost per line is $12.30.[71] Thus, wholesale expenses are about 32% less than retail expenses per

[66] The null hypothesis of equality of the coefficients on DBLS and DVZ could not be rejected (F=0.42). These two coefficients were statistically different than the coefficient on DQWST.

[67] *See, e.g., supra* n. 2.

[68] The ARMIS data is available at the FCC's website: www.fcc.gov/wcb/armis/db.

[69] Access lines include both switched and special access lines. This approach to computing average cost per access line assumes that costs are appropriately spread proportionally across the different types of access lines.

[70] Access Expenses are charges paid by the ILEC to other ILECs. A UNE-P carrier is responsible for these charges for its customers.

[71] The standard deviations are 2.86 and 2.31, respectively.

line. The differential of $5.90 is broadly consistent with ... computed using the resale discounts (which apply to retail revenues).[72]

The EBITDA margin of the BOCs for retail and wholesale customers is computed by subtracting revenues from these operational expenses. The average retail margin is $21.86, and the average wholesale margin is $8.03. BOC specific revenues, costs, and margins are summarized in Table 3.[73] The EBITDA margins in percentage terms (revenues minus cost divided by revenues) for retail and wholesale services average 55% and 40%, respectively. The wholesale EBITDA margin averages about 40% of the retail EBITDA margin.

For the computation of per-line expenses it was assumed that expenses are proportionately allocated between switched and special access lines (the latter measured on a voice-grade equivalent basis). Further, ARMIS "Total" expenses were used rather than "Regulated" expenses. There is good reason to exclude "Non-Regulated" expenses because "Non-Regulated" services cannot be purchased as unbundled network elements. Table 4 summarizes wholesale cost calculations using alternate assumptions and inputs. Specifically, "Regulated" expense data from ARMIS is used rather than "Total" expenses (including expenses from regulated and non-regulated services). Three alternative allocation methods are employed. For Method 1, "Regulated" expenses are divided by switched and special access lines as before. Because regulated expenses are less than total expenses, the per-line wholesale costs are less for Method 1 than those provided in Table 3. Method 2 allocates expenses between switched and special lines using the allocation factor derived from ARMIS Form 43-01.[74] Expenses allocated to switched access lines are then divided by switched-access lines only to compute per-line costs. Because the BOCs are incented for regulatory purposes to over allocate expenses to switched access lines, Method 3 reduces the allocation factor by 75%. As illustrated by Table 4, these alternative methods do not materially affect the findings summarized above.

[72] According to UBS Warburg's model, per-line avoided costs (based on resale discounts) are about $5 per month.

[73] The values in the table represent access line weighted averages.

[74] The allocation factor for each state is computed by dividing "Special Access" expenses ("Total Operating Expenses") by expenses "Subject to Separations." One minus this number is the share of expenses allocated (by the BOCs for regulatory purposes) to switched access lines.

VI. Conclusion

Despite the claims made by numerous ILEC executives to Congress, to the Bush Administration and to the FCC, State commissions simply have not set wholesale prices for UNEs based on retail prices instead of forward-looking costs. By far, forward-looking costs contribute most to the determination of wholesale UNE prices for UNE-P when compared to embedded costs, retail prices, or the retail opportunity cost of the ILEC. Econometric evidence suggests that retail opportunity cost (ECPR) also plays an important role in wholesale price setting. Overall, the evidence presented in this Policy Paper suggests that State regulators have, to a large extent, set wholesale prices between forward-looking cost and the ECPR rate. It appears, as is common in regulatory proceedings, the interests of both parties have been balanced. This Policy Paper also provides evidence that BOC second-hand claims that UNE-P revenues are below operational costs are incorrect. Estimates of retail and wholesale revenues and operational costs reveal positive EBITDA margins for all BOCs, with EBITDA margins for retail and wholesale of 55% and 40%.

All said, therefore, the States are doing a good job of implementing their responsibilities under the 1996 Act. The fact that BOC margins are declining is an intended consequence of Section 251(d) the 1996 Act and a rational public policy, because TELRIC pricing deliberately does not incorporate the monopoly rents the BOCs have traditionally enjoyed in the wholesale prices for UNEs.

Table 1: Descriptive Statistics

Variable	Definition	Mean	St Dev	Source
P	Price for the UNE-P	[illegible]	[illegible]	(1)
	[Unadj. Capital Commerce Mkt data]	[23.42]	[5.68]	(2)
C	Estimate of Statewide average cost for loop and switching.	21.37	5.44	(3)
T	Residential retail rate for local phone service.	21.07	3.75	(4)
M	Average revenue per switched access line minus C.	21.54	5.20	(5)
E	Estimate of Statewide average embedded costs per voice-grade line.	36.12	5.15	(5)
A	Average revenue per switched access line.	42.80	6.66	(5)
DBLS	Dummy variable for BellSouth States.	0.20	...	
DVZ	Dummy variable for Verizon States.	0.24	...	
DQWST	Dummy variable for Qwest States.	0.31	...	

Correlation Matrix
(Log-form upper right, Level form lower left)

	P	C	T	M	E
P	1.00	0.72	0.45	-0.05	0.59
C	0.72	1.00	0.47	-0.18	0.57
T	0.45	0.51	1.00	0.16	0.58
M	-0.04	-0.21	0.10	1.00	0.08
E	0.54	0.59	0.60	0.08	1.00

(1) CCMs (2002) adjusted by Z-Tel Communications (Confidential).
(2) CCMs (2002).
(3) FCC's Hybrid Proxy Cost Model.
(4) Gregg (2001).
(5) ARMIS 43-03 (2001). Computed as sum of Row 5001, 5002, 5050, 5060, 5069, 5081, 5082, 5084, 5110, and 5160, divided by switched access lines (from ARMIS 43-08, 2001).

Table 2. Regression Results

Variable	Model 1 (Eq. 3a) Coefficients	Model 2 (Eq. 3b) Coefficients	Partial R^2	Model 3 (Level)	Model 4 (Level) Coefficients
Constant	8.05 (−1.33)*	0.837 (-1.19)*	...	8.08 (-1.33)*	-4.916 (-1.01)*
C	1.028 (4.31)*	0.811 (4.50)*	(0.33, 0.35)	0.056 (2.94)*	0.982 (5.15)*
T	-0.364 (-1.34)	-0.305 (-1.63)	(0.05, 0.07)	-0.364 (-1.34)	-0.385 (-1.78)
M	0.462 (2.05)*	0.344 (2.15)*	(0.10, 0.11)	...	0.670 (3.72)*
E	0.122 (0.59)	0.344 (1.36)	(0.01, 0.05)	0.122 (0.59)	-0.080 (-0.49)
DBLS	8.56 (3.50)*	0.360 (4.25)*	...	8.56 (3.50)*	0.259 (-0.133)
DVZ	10.708 (3.88)*	0.457 (4.19)*	...	10.708 (3.88)*	8.812 (4.00)*
DQWST	3.981 (2.06)*	0.205 (2.97)*	...	3.981 (2.06)*	6.155 (3.99)*
A	...	...	...	0.462 (2.05)*	...
R^2	0.73	0.77		0.73	0.65
Adj. R^2	0.68	0.72		0.68	0.58
F-Statistic	14.45*	17.44*		14.45*	9.79*
RESET F	0.10	0.38		0.10	4.84*

* Statistically Significant at 5% level or better (two-tailed test).
** Statistically Significant at 10% level or better (two-tailed test).

Table 3. Retail and Wholesale Margins for the BOCs

	Revenues		Operational Costs		Margin	
	Ret.	Whol.	Ret.	Whol.	Ret.	Whol.
BellSouth	$49.04	$24.38	$16.84	$10.74	$32.20	$13.64
Qwest	42.14	23.98	17.99	12.24	$24.15	$11.74
SBC	35.16	20.29	17.69	11.62	$17.47	$8.67
Verizon	39.13	17.31	19.86	14.23	$19.27	$3.08
Avg.	40.06	20.33	18.20	12.3	$21.86	$8.03

Note: Access line weighted averages.

Table 4. Alternative Calculations for Wholesale Costs Per Line

	From Table 3	Method 1	Method 2	Method 3
BellSouth	$10.74	$8.65	$13.77	$10.06
Qwest	12.24	11.07	14.53	10.80
SBC	11.62	9.71	14.51	10.74
Verizon	14.23	12.71	15.85	12.66
Avg.	12.30	10.53	14.80	11.23

Unbundling and Facilities-Based Entry by CLECs: Two Empirical Tests

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In this paper, the determinants of the provision of facilities-based lines by competitive local exchange carriers ("CLECs") are examined using data collected by the Federal Communications Commission and the entry decisions of a large, facilities-based CLEC. The multiple regression models are based on the economics of entry, considering both the effects of market size and sunk costs on provision of facilities-based service to end-users by CLECs.

Following Martin (1988), Sutton (1990) and Beard and Ford (2002), the extent of facilities-based entry by CLECs is assumed to be a positive related to market size and inversely related to the fixed/sunk costs of entry.[1] Size is measured as the total revenues of the Bell Operating Company ("BOC") in the state (*SIZE*) in millions of dollars. Sunk cost requirements are assumed to be inversely related to the density of market size, measured as BOC total revenues per square mile (*DENSE*). The percent of the state's population living in metropolitan areas, another measure of density, should also reduce the sunk costs of facilities investment (*METPOP*).[2]

The unbundling obligations and the companion pricing standard for unbundled elements may influence facilities-based entry in a variety of ways. So, the unbundled loop (highest density zone) and switching price in the state (*PLOOP*, *PSWITCH*) are included as regressors in the model.

Positive signs are expected on the market size and density variables (*SIZE*, *DENSE*, and *METPOP*). No a priori expectations are made with respect to the unbundled loop prices, since either a positive or negative sign is consistent with theory - element prices are ambiguously related to market size and the (exogenous and/or endogenous) sunk costs of entry.[3] Lower element prices, for example, may lead to more intense price competition and/or indicate a more favorable regulatory environment. Complementarity between elements and facilities may assist facilities-based entry by expanding market size or reducing entry costs. Additionally, unbundled element rates are estimates of average incremental cost at minimum viable scale. Thus, the element rates may serve as reasonable proxies for the average cost of duplicative network.[4]

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[1] The equilibrium number of firms in an industry, N^*, can be written as $N^* = (S/E)^{0.50}$, where S is market size and E is sunk entry costs. See, e.g., JOHN SUTTON, SUNK COST AND MARKET STRUCTURE (1990), Ch. 3; T. Randolph Beard and George S. Ford, *Competition in Local and Long-Distance Telecommunications Markets*, *in* INTERNATIONAL HANDBOOK OF TELECOMMUNICATIONS ECONOMICS, Volume I (Gary Madden ed. 2002) *and* STEPHEN MARTIN, INDUSTRIAL ECONOMICS: ECONOMIC ANALYSIS AND PUBLIC POLICY (1988), at 197-98.

[2] RCN, a facilities-based entrant, has limited its entry to the most densely populated markets (RCN 2001 10-K).

[3] Facilities-based entry is more common in dense markets, and loop prices are lower in dense markets (which is expected). The average loop price in the five largest CLEC facilities-based markets is about 30% less than the smaller markets (means difference t-stat = 2.72). If the density measures in the regression do not properly account for the total influence of density on entry, then the sign on the loop price may simply arise from this correlation, and not causation *per se*.

[4] Cost equivalence is not required, just correlation.

Finally, Beard and Ford (2002) and Ekelund and Ford (2002) show that that entry using unbundled elements is higher in markets where element prices are lower (i.e., element demands slope downward).[5] Thus, the relationship between entry via elements and facilities also is measured by the coefficients on the element prices.[6]

The estimated (semilog) regression equation is

$$\ln FBE_i = a_1 + \sum_{j=2}^{6} a_j X_i + \varepsilon_i,$$

where all the X_i are measured at the state level i (BOC data only) and ε is a well-behaved, econometric disturbance term. Two vintages of the dependent variable data (Dec-2000 and June-2001) are used to estimate the equation.[7] Data limitations produce 62 usable observations.

The quantity of CLEC facilities based lines (*FBE*) is compiled by the FCC (Form 477 data). Market size (*SIZE*) is provided by ARMIS 43-04 (Year 2000). Square miles and metropolitan population are census data. The loop price (*PLOOP*) is the loop price for the highest density zone (Gregg 2001).[8] Switching element price (switching and transport) is based on individual element prices from interconnection agreements and state tariffs.

The results of the least squares regression are summarized in Table 1. The R-square of the regression is 0.83, so the model explains 83% of the variation in the dependent variable. All variables but *DENSE* are statistically significant at the 2% level or better in a two-tail test. *DENSE* is statistically significant at the 8% level in a one-tail test. Ramsey's RESET test does not indicate that specification error is a problem (22% significance level), but White's test rejects homoskedastic disturbances (4% significance level). Thus, White's standard errors are used to compute the t-statistics reported in the table.

All market size and sunk cost proxy variables (*SIZE*, *DENSE*, and *METPOP*) have the correct sign (positive), and only *DENSE* is not statistically significant at standard levels (for a two-tail test). While unbundled element prices may influence facilities-based entry in a variety of ways, the regression results indicate that unbundled element prices have negative and statistically significant relationships to facilities-based entry by CLECs. The estimated elasticities of primary interest include 0.48 for *SIZE*, -0.43 for *PLOOP*, and -0.55 for *PSWITCH*. A 10% increase in the loop rate, for example, reduces CLEC facilities-based entry by about 4%. The elasticities of demand for the elements themselves are elastic, averaging about -1.5.[9]

Table 1. Least Squares Results

Variable	Coef. (White t-stat)	Mean (St. Dev.)
Constant	9.84	
	(16.38)	
SIZE	0.27	2.39
	(11.45)	(2.10)
DENSE	0.003	21.27
	(1.45)	(25.87)
METPOP	2.35	0.75
	(3.85)	(0.15)
PLOOP	-0.032	12.55
	(-2.31)	(4.22)
PSWITCH	-0.035	13.73
	(-3.13)	(6.14)
FBE		154,018
		(173,971)
R^2	0.82	
White F	2.41	
RESET F	1.64	

In an alternative regression, the entry of RCN Communications in particular markets (states) is evaluated. RCN is the largest facili-

[5] T. R. Beard and G. S. Ford, *Make or Buy? Unbundled Elements as Substitutes for Competitive Facilities in the Local Exchange Network* (June 2002) and R. B. Ekelund Jr. and G. S. Ford, *Preliminary Evidence on the Demand for Unbundled Elements* (June 2002).

[6] Simultaneity bias precludes the estimation of one type of CLEC output (facilities-based, elements, resale) on another, without an estimation technique that properly accounts for the joint determination of the two series.

[7] Preliminary regressions indicated no statistically significant difference between the output levels of the two vintages.

[8] Billy Jack Gregg, *A Survey of Unbundled Network Element Prices in the United States* (2001).

[9] See Beard and Ford (2002) and Ekelund and Ford (2002).

ties-based provider of telephone, cable, and internet services to residential subscribers. The company provides service to more than one-million subscribers in six markets: New York, Massachusetts, Pennsylvania, Illinois, California, and the District of Columbia.[10] It is worth noting that about 12% of RCN's end-user service is provided over incumbent local exchange facilities.[11]

RCN's entry into a market is indicated by a dummy variable equal to 1.00 in the above listed markets, 0 otherwise (*DRCN*). The same explanatory variables are used with the exception of *PSWITCH*, which is excluded because the missing values for the variable reduce the already small number of RCN markets.

A total of 48 observations are used to estimate the probit equation, and results are summarized in Table 2. Reported t-statistics are based on robust standard errors. The McFadden R-square (likelihood ratio index) for the probit is 0.75

As before, size is found to positively influence entry, whereas sunk costs reduce entry. Both *SIZE* and *DENSE* are statistically significant at standard levels (*METPOP* is significant at the 10% level in a one-tail t-test). The probability RCN enters a particular market is negatively related to the unbundled loop price (*PLOOP*).[12] The *PLOOP* variable is statistically significant at better than the 5% level.

Table 2. Probit Results for RCN Entry

Variable	Coef. (t-stat)	Coef. (t-stat)	Mean (St. Dev.)
Constant	-6.03	-10.52	
	(1.15)	(1.80)	
SIZE	0.54	0.32	1.79
	(2.83)	(2.44)	(1.95)
DENSE	0.001		96.06
	(5.05)		(521.0)
METPOP	8.49	14.48	0.68
	(1.29)	(2.02)	(0.21)
PLOOP	-0.42	-0.39	13.47
	(-2.28)	(-3.06)	(4.87)
DRCN			0.125
			(0.33)
McFadden R^2	0.75	0.68	

The District of Columbia is a clear outlier for the *DENSE* variable, and a RCN market.[13] In an alternate specification, *DENSE* is excluded as a regressor. In this regression, METPOP is statistically significant at better than the 5% level. The coefficient on *SIZE* declines slightly, but the *PLOOP* coefficient is not materially altered.

These estimated regressions indicate that CLEC facilities-based entry is positively related to market size and inversely related to the sunk costs of entry. Both regressions indicate that unbundled element prices are inversely related to facilities-based entry. While the exact determinants of these inverse relationships cannot be determined (by these models), the results indicate that, on average and other things constant, higher element rates are associated with a reduced amount of facilities-based entry by CLECs.

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[10] RCN 2001 10-K. Because RCN is the incumbent operator in its New Jersey markets, we exclude New Jersey as a market in which RCN is an entrant.

[11] RCN 2001, 3 Qtr 10-Q.

[12] The average loop price in RCN markets is about 63% of the average loop rate in other markets (means-difference t = 2.57).

[13] The sizeable increase in the standard deviation of *DENSE* (relative to Table 1) is attributable to the inclusion of the District of Columbia.

Preliminary Evidence on the Demand for Unbundled Elements

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The Telecommunications Act of 1996 requires incumbent local exchange carriers to lease elements of their networks to competitors to promote competition in monopoly markets. Prices for these elements are set by state regulatory commissions based on estimates of cost. The development of competition and, consequently, the success of the Act depends on UNE prices since demand for unbundled network elements (UNEs) slopes downward. This note provides the first empirical evidence on the demand for UNEs.

To date, the most successful form of competitive entry using elements is the UNE-Platform – a combination of unbundled loops and end-office switching, so our analysis focuses on that entry mode. A reasonable approximation of the ordinary demand for UNE-Platform is

$$\ln Q_i = \alpha_0 + \alpha_1 \ln P_i + \sum_{j=1}^{n} \alpha_j Z_i + \varepsilon_i \tag{1}$$

where Q is the quantity demanded of loop-switching combinations in state i, P is the regulated price for loop-switching combinations in i, Z is a vector of other factors that affect demand in i, and ε is the disturbance. Variables in Z include: (Z_1) total demand, measured as the local service revenue in the state; (Z_2) the percent of total, analog switched access lines serving residential customers; (Z_3) a dummy variable for New York and Texas, both leading states in the promotion of competition; (Z_4) a dummy variable if the incumbent is allowed to provide interLATA long distance (AR, KS, MA, MO, NY, OK, PA, TX,); (Z_5) a dummy variable if the installation charge to competitors for the element combination exceeds \$50; and (Z_6) a dummy variable for the dependent variable's date (0 for June 2001, 1 for December 2001). The Federal Communications Commission provides data for Q, Z_1, and Z_2, and all price data is provided by Z-Tel Communications.

The estimated regression is

$$\ln Q = 6.1 - 2.7 \cdot \ln P + 0.3 \cdot \ln Z_1 + 0.75 \cdot Z_2 + 2.7 \cdot Z_3 + 0.33 \cdot Z_4 - 1.0 \cdot Z_5 + 0.15 \cdot Z_6 + \varepsilon . \tag{2}$$

Results from the least squares estimation are excellent. The R^2 is 0.68, and Ramsey's RESET Test indicates correct specification. The variables P, Z_3 and Z_5 are statistically significant at the 5% level (t = -4.84, 4.43, -2.10), and Z_1 at the 10% level (t = 1.66). The (derived) demand for loop-switching combinations increases in total market demand, is higher in New York and Texas, and declines with high installation fees. Other variables show no effect.

The own-price elasticity of demand is in the elastic region of demand (-2.7), as is the entire 95% confidence interval (–1.6 to –3.84). The quantity demanded is highly sensitive to price, and state regulators that set higher prices are reducing substantially the level of competition provided over the UNE-Platform. This result suggests that competition is inhibited where the prices of elements are high. These estimates should assist state regulators in assessing the impact of element rates that are typically determined in complex and adversarial rate proceedings.

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Innovation, Investment, and Unbundling: An Empirical Update

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I. Introduction

In Winter 2000 issue of this *Journal*, Thomas Jorde, Gregory Sidak, and David Teece (JST) commented on some potential economic consequences of the Telecommunications Act of 1996 as implemented by the Federal Communications Commission (FCC). The article, published early in the implementation phase of the Act, contained many general assertions about potential consequences, but contained no empirical evidence. JST did, however, offer some interesting and testable propositions. One of them suggests an important issue, for which implementation is rather straightforward: JST propose that mandatory unbundling increases the "riskiness and cyclicality of the ILEC's [Incumbent Local Exchange Carriers] economic performance and, hence, on the ILEC's weighted-average cost of capital. Mandatory unbundling raises both components of the weighted-average cost of capital for ILECs – equity and debt" (2000: 19). The purpose of this brief comment is to perform that empirical test and to compare our empirical results with the expectations of JST.

II. The Impact of Mandatory Unbundling: An Empirical Test

The goal of the Telecommunications Act of 1996 was to "promote competition" and "reduce regulation" (1996 Act, Preamble). As part of this effort, the Act required the ILECs to lease the elements of their networks – unbundled elements – to their rivals at prices commensurate with costs. JST conclude that mandatory unbundling will have adverse affects on the investment of both the incumbent phone companies as well as prospective entrants. One of the many alleged sources of these investment distortions was the effect of mandatory unbundling on the incumbent local exchange carriers' (ILECs) cost of capital.

With regard to the cost of equity, the authors indicate "[t]he cost of equity capital depends on the systematic or 'beta' risk of the firm. ... How does mandatory unbundling affect an ILEC's beta and thus its cost of equity? The answer depends on how unbundling affects the cyclicality of an ILEC's return" (2000: 19). JST assert that the mandatory unbundling increases the cyclicality of the ILECs' return, so beta should increase during an economic downturn. During periods of "weak demand" (i.e., recession), according to JST, the justification of facilities deployment is more difficult for CLECs. During these periods these firms are more likely to lease unbundled elements than to construct their own facilities. Weak demand for telecommunications services compounded with an increased demand for unbundled elements, both of which lower end-user prices and thus profits, and the potential the elements are priced below costs, all "intensif[y] the cyclicality of an ILEC's returns" (2000: 19).

Assessment of the impact of a recession (or any event for that matter) on a firm's beta coefficient is straightforward, and such analysis is frequently employed. A firm's beta is estimated by:

$$R_i = \alpha_i + \beta_i R_m + \varepsilon_i \tag{1}$$

where the R_i is the stock return on firm i, R_m is the return on a broad market index, α_i is the intercept, β_i is the beta for firm i, and ε_i is the econometric disturbance term. Equation (1) is estimated by ordinary least squares (OLS), and typically employs daily or monthly returns over periods of various time intervals.

In the present context, it is not the firm beta that is of primary interest, but the difference in beta between a period of economic expansion (β^E) and economic recession (β^R). A statistical test for the non-stationarity of beta across time periods involves a slight modification to Equation (1):

$$R_i = \alpha_i + \beta_i R_m + \gamma_i D + \Delta_i D \cdot R_m + \varepsilon_i \tag{2}$$

where D is a dummy variable that equals 1.00 during the period of economic recession (0 otherwise), γ_i measures the change in the intercept during the recession, and, most importantly, Δ_i measures the change in beta during the recession period (Daves, et al., 2000). From Equation (2), the expansion and recession betas can be computed, where $\beta^E = \beta_i$ and $\beta^R = \beta_i + \Delta_i$. The JST hypothesis is that $\Delta_i > 0$, so that the $\beta^R > \beta^E$. The statistical significance of the estimated coefficient Δ_i measures the statistical significance of the null hypothesis that $\beta^R = \beta^E$.

For obvious reasons, JST did not perform this statistical test of their hypothesis regarding the cost of equity capital in their article. As the authors observe, "there has not been a recession since the Telecommunications Act of 1996 [so] the conjecture about increased systematic risk is not falsifiable" (2000 19). At the time of publication, the U.S. was in the midst of one of the longest economic expansions in history. According to the National Bureau of Economic Research, however, this economic expansion ended in March 2001 and has continued until the present (June 2002). Thus, this empirical test of the JST hypothesis can be performed.

Equation (2) is estimated using daily stock returns for the three Regional Bell Operating Companies (RBOCs) -- BellSouth (BLS), Verizon (VZ), and Southwestern Bell (SBC) – and an index of the three companies.[1] The market index is measured by the S&P 500. Betas are computed using data for three (224 observations) and five years (328 observations) preceding the recession (March 2001), producing a total of eight regressions.[2] Regression results and the estimated values of β^E and β^R are summarized in Table 1. To improve efficiency of the estimates, the regressions are estimated using generalized least squares.[3]

[1] This index was computed as a simple average of the stock prices of the three RBOCs.

[2] Data for the recession period spans March 2001 through June 17, 2001 (the latter being the last reported stock price for the date the data was collected). The three-year betas were computed at the start date March 1998, and the five-year betas were computed with a start data of March 1996. The recession period includes 67 observations. Historical data is provided at no charge by finance.yahoo.com.

[3] For all regressions, the null hypothesis of homoscedastic errors is rejected.

Table 1 Regression Results

RBOC	α_i	β_i	γ_i	Δ_i	R^2	β^E	β^R
BLS (3 Year)	0.003 ([illegible])	0.320 ([illegible])	0.005 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]
BLS (5 Year)	0.003 (1.05)	0.482 (4.89)*	0.005 (0.97)	-0.215 (1.11)	0.08	0.48	[illegible]
VZ (3 Year)	0.002 (0.46)	0.547 (4.57)*	-0.003 (0.46)	-0.143 (0.68)	0.11	0.55	0.40
VZ (5 Year)	0.001 (0.58)	0.603 (6.56)*	-0.003 (0.51)	-0.198 (1.10)	0.14	0.60	0.40
SBC (3 Year)	0.002 (0.57)	0.695 (4.98)*	-0.006 (0.89)	-0.418 (1.71)*	0.11	0.70	0.28
SBC (5 Year)	0.002 (0.61)	0.719 (6.89)*	-0.006 (0.98)	-0.442 (2.16)*	0.14	0.72	0.28
Index (3 Year)	0.002 (0.61)	0.520 (4.84)*	-0.005 (-0.84)	-0.198 (1.05)	0.12	0.52	0.32
Index (5 Year)	0.002 (0.75)	0.598 (7.20)*	-0.004 (-0.93)	-0.276 (1.70)*	0.15	0.60	0.32

* Statistically significant at the 5% level or better.

All the estimated betas (β_i) for the RBOCs are less than 1.00 and statistically significant. None of the constant terms (α_i, γ_i) are statistically different from zero. The estimated coefficient Δ_i is of primary interest. For all three RBOCs and an index of the companies, the estimated coefficient Δ_i is *negative*. In no case is a positive value for Δ_i observed. For three of the eight regression models, the null hypothesis of an equal beta during economic expansion and recession is rejected. For SBC (3 and 5 year) and the index (5 year only), the recession beta is less than the expansion beta ($\beta^R < \beta^E$). In no case can the JST hypothesis that $\beta^R > \beta^E$ be accepted, and in three cases it is rejected at the 5% significance level. Consistently, it appears that the recession has reduced, if anything, the variability of the RBOC stocks and, consequently, reduced the cost of equity capital.

III. Conclusion

The Telecommunications Act of 1996 was passed to promote competition in one of the most advanced technological areas of the economy. A major debate has raged concerning the impact of mandatory unbundling as a means of introducing competition in local exchange markets. One proposed hypothesis is that mandatory unbundling increases the riskiness and cyclicality of ILECs performance, creating an adverse impact on their cost of capital. In addition to the effects of a generalized weaker demand for ILEC services during downturns, these firms would be faced with an increased demand by CLECs for unbundled elements. Such factors would both intensify the cyclicality of ILECs returns and increase capital costs.

Using a standard model for risk measurement and data for RBOC that includes periods of both expansion and recession we find no evidence that recession increases the variability and risk of ILEC stocks. Indeed, there is some evidence that the opposite might be the case. This implies that, on these grounds, mandatory unbundling does not increase the financial vulnerability of ILEC firms and their cost of equity capital.

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